The Monthly Review

Published by the AMERICAN ELECTRO-PLATERS' SOCIETY

MAY 1937

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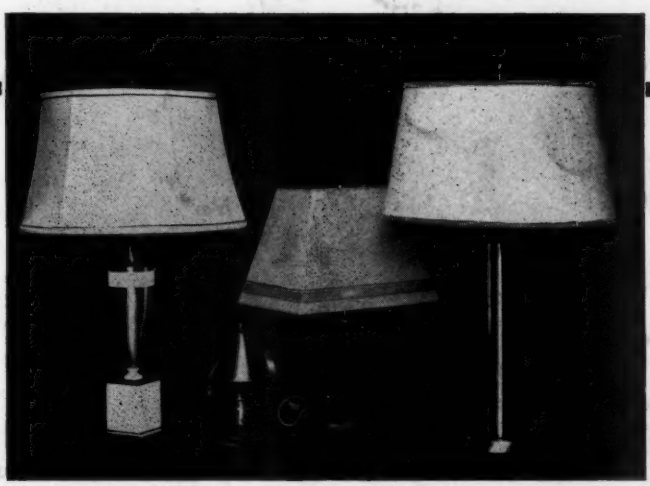

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The Monthly Review

Published by the AMERICAN ELECTRO-PLATERS' SOCIETY

A Society for the Advancement of the Science of Electro-Plating

MAY 1937

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An Appreciation

Now that the time is drawing near for the convening of the 1937 Annual Meeting of the American Electro-Platers' Society in the City of New York, June 14th to 17th inclusive, the twenty-fifth annual and Silver Jubilee Convention of the Society, which marks the quarter century of progress of the A. E. S. as an educational and scientific society, I, as general chairman of the New York Convention Committee, desire to take the opportunity afforded me at this time through the columns of our MONTHLY REVIEW, to express the appreciation of the New York Convention Committee to all those who have in any way contributed to the effort to make the Silver Jubilee of the Society all it should be. To those who have graciously offered their services in the matter of Educational presentations, to this all important part of the programme, we wish to offer our thanks and express our satisfaction to the technical men with their scientific data and developments and to the practical plater who has come forth valiantly with his contribution for this occasion. To the supply house and plating equipment manufacturers, we wish to thank wholeheartedly for their support. To the advertisers in our official Programme Booklet, who have so substantially assured the financial success of the Convention, we are grateful for their manifestation of good will and co-operation. To the International Fellowship Club, who once again have shown their interest and intention to play the part of the "Genial

Host" to the registrants of the A. E. S. Conventions, we want to express our satisfaction in their effort to assure the social success of the Jubilee at New York.

To the Branches and individuals who are responding to the appeal of Chairman Liguori of the Exhibit feature of Plated Wares and Products, we say "Thank you".

To President Thompson of the A. E. S. who has helped a lot with suggestions and advice on many details and to past president Horace Smith of Newark for his fine assistance to our Committee, and to the Editor of our MONTHLY REVIEW who has at all times rendered full co-operation in publicizing the Convention and entering into detail with the Committee, we want to express our feeling of thankfulness.

To all those publications in the metal finishing field who have proferred their columns for the publicizing of the features of the 1937 Convention, we are indebted indeed.

To all of those who have in any way contributed to and furthered the progress of the Silver Jubilee at New York, we want to express again our appreciation and pride in that which they have tried to do.

NEW YORK CONVENTION COMMITTEE,
FRANKLYN J. MACSTOKER, *Chairman*

MR. BERT G. DAW IS MAKING A SPEEDY RECOVERY

It is a great pleasure to announce to our readers that the well known Lasalco representative, Mr. Bert G. Daw, is quickly recovering from a serious auto accident recently. Bert is back home again after being in the hospital at Schenectady.

We hope he continues to improve so that his many friends will greet him at the Convention where he is always a familiar figure.

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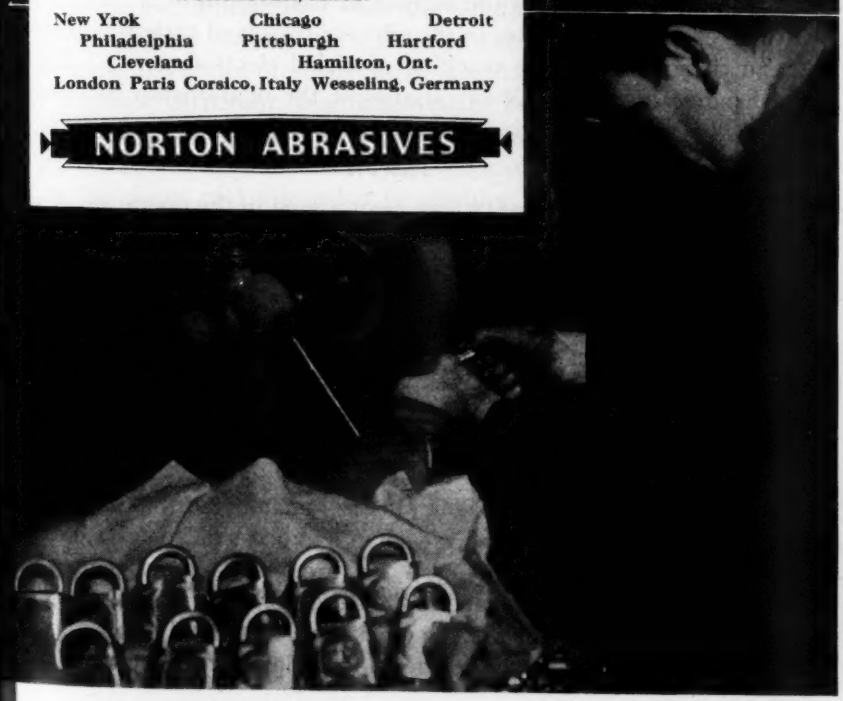

Some Factors *Governing the Ductility of* Nickel Electrodeposits

By E. A. ANDERSON
Chief, Metal Section, Research Division
The New Jersey Zinc Company
Palmerton, Pennsylvania
Read at Cleveland 1936 Convention

THERE has been, in the last few years, a growing recognition of the need for more information on the factors controlling the ductility of electrodeposits, particularly those of nickel. The weights of coating required by the specifications sponsored by this Society impose distinct limitations on the minimum ductility of the coatings to prevent cracking under the stresses inherent in electrodeposits.

There has been surprisingly little literature on the subject and it is hoped that the material presented here will represent a definite contribution. The subject matter of this paper is made up of two experiments which are related to each other only in their common application to the subject of coating ductility. One of these experiments relates to the effect of dissolved carbon dioxide and carbonates on the cracking of nickel electrodeposits. The other relates to some X-ray studies of the relationship between ductility and crystal orientation.

PART I.

Some time ago, difficulty was encountered in the operation of a laboratory bath of the following composition:

Nickel sulphate	10	ounces	per	gallon
Anhydrous sodium sulphate	15	"	"	"
Ammonium chloride	2	"	"	"
Boric acid	2	"	"	"

This bath was used at room temperature for the deposition of nickel on zinc. At the time referred to, cracking of the deposits had become excessive and variations in temperature, pH, and current density did not clear up the trouble.

In thinking over the problem, it was remembered that a day or so previous to this experience we had had occasion to agitate the bath by the violent bubbling of air through it. This suggested the possibility that some one of the gases normally present in the air might be responsible for the cracking. Accordingly, some preliminary experiments were made on small laboratory lots of solu-

tion through which such gases as oxygen, nitrogen, carbon dioxide, etc., were bubbled and electrodeposits made under standard conditions. These tests demonstrated beyond any doubt that carbon dioxide was the only gas among those tested which, in solution could cause cracking in nickel deposits. A study was then made to determine the minimum or threshold quantity of carbon dioxide required and to determine whether or not sufficient carbon dioxide in the form of gas or carbonate could be expected to be present in commercial plating solutions to cause this type of trouble.

To carry out the proposed tests, a plating bath consisting of seven liters of the following solution was adjusted to a pH of 5.45 (electrometric):

Nickel sulphate	10	ounces	per	gallon
Anhydrous sodium sulphate	15	"	"	"
Ammonium chloride	2	"	"	"
Boric acid	2	"	"	"

Two by six inch test specimens of rolled zinc 0.020" in thickness were plated to a thickness of 0.0003" at a current density of 18 amperes per square foot with the solution at a temperature of 26° C. These coatings were free from cracks as would normally be expected under these operating conditions.

Sodium carbonate was dissolved in boiled distilled water to form a stock solution of which 1 cc. contained 0.01 gram of sodium carbonate. Small amounts of this stock solution were then added to the above nickel solution to produce the two series of increments of sodium carbonate in the solution shown in Table I.

TABLE I

Na_2CO_3 Concentrations Tested in Nickel Solution

No.	*cc. of Na_2co_3 Solution Added-Cumulative*	*Concentration of Na_2CO_3 in Nickel Solution Gram Per Liter*
H-970	0	--
H-971	14.0	0.02
H-972	21.0	0.05
H-973	35.0	0.10
H-974	35.0	0.15
H-975	70.0	0.25
H-976	140.0	0.45
H-1016	0	--
H-1019	21.0	0.03
H-1020	14.0	0.05
H-1021	35.0	0.15
H-1022	210.0	0.40

Since the addition of the sodium carbonate solution raised the pH of the plating solution, a small amount of dilute sulphuric acid was added in each case to bring the pH back to its initial value, that is, 5.45 (electrometric). Deposits of 0.0003″ in thickness were prepared in each solution using the same current density and bath temperature noted above. The deposits were inspected at a magnification of 24 diameters both before and after buffing. There is no question but that the sodium carbonate was capable of producing distinct edge cracks when as little as 0.03 gram per liter was present. In other specimens, cracking was detected at 0.02 gram per liter.

A second set of tests involved the addition of carbon dioxide as the gas. In order to carry out this test, a quantity of the same nickel plating solution was saturated with carbon dioxide by bubbling the pure gas through it for some time at room temperature. This solution was analized to determine its carbon dioxide content after which small amounts were added to a pure solution to secure the following steps of gas concentration:

Table 2
Carbon Dioxide Concentrations in Plating Solutions Tested

No.	*cc. Added of Plating Solution Saturated with CO_2—Cumulative*	*Concentration of CO_2 in Final Plating Solution—cc. Per Liter***
H-1023	0	—
H-1024	150	8.4
H-1025	300	22.4
H-1027	1000	73.5

*Gas volumes given as of standard conditions of temperature and pressure.

The carbon dioxide content in the nickel plating solution was determined analytically by the modified method of Petterson.[1] This is a volumetric method commonly used in the determination of carbonic acid in sea water and consists in evolving the carbon dioxide from the solution by means of an acid. The evolved gas is collected over mercury and the contraction of volume is measured after passing the collected gas over a 50 per cent potassium hydroxide solution. In the present tests, sulphuric acid was used to acidify the solution. Analyses made before and after the plating of specimens revealed no significant change in gas concentration.

Carbon dioxide, when present as dissolved gas, can produce edge cracking with as much facility as when added as the carbonate. A concentration of 4.9 cc. of carbon dioxide per liter of plating solution was sufficient to initiate cracking. It may be noted that the threshold quantity of 0.2 gram per liter of sodium carbonate contains the equivalent of 4.2 cc. per liter of carbon dioxide. It would seem, therefore, that the cracking effect is directly related to the presence of carbon dioxide regardless of how added. It is, of course, entirely reasonable that this should be so in a solution of the type used here and at the pH 5.45 employed.

In view of the very definite embrittling effect of carbon dioxide, serious consideration was given to the question of how frequently the plater might expect to encounter trouble from this source in practical plant operation. This was particularly important because carbonates are frequently employed in solution purification and because it has not heretofore been clearly established that their presence can be detrimental to ductility. It was soon discovered, by direct experiment, that both carbon dioxide and carbonates are readily removed from the nickel solution. In one experiment, an addition of 0.4 gram per liter of sodium carbonate was made to a nickel plating solution at a pH of 5.4. Coatings 0.0003″ in thickness plated at 18 amperes per square foot at 26°C. were found to be seriously cracked. After the solution was permitted to stand for six days in the laboratory, crack-free deposits were obtained.

In another experiment, a solution containing 70 cc. per liter of carbon dioxide showed only 0.2 cc. per liter present after standing for sixteen days. Analyses of laboratory nickel plating solutions which had been exposed to the laboratory atmosphere for long periods of time indicate that when the pH is below 6.0 not more than 0.4 cc. of carbon dioxide per liter will be absorbed. This amount of carbon dioxide is insufficient to cause cracking.

It is evident, therefore, that carbon dioxide will not be absorbed from the atmosphere in sufficient quantity to initiate cracking and hence the only sources to be encountered in practical work would be from the use of air agitation in cold solutions, from carbonates present as impurities in plating salts and from carbonates used in solution purification. Given reasonable time,

1. Treadwell and Hall, *Analytical Chemistry*, Vol. II, page 338 (1924)

any carbon dioxide in the solution will be reduced on simple standing to below the threshold value required to initiate cracking.

In many cases it will be necessary to remove carbon dioxide and carbonates in a comparatively short time. This may be accomplished by reducing the pH, boiling the solution, agitating with carbon dioxide free air or any combination of these treatments. In several cases, sufficient removal of sodium carbonate to permit the production of crack-free deposits was accomplished by reduction of the pH to 1.3 and boiling for fifteen minutes. The bubbling of carbon dioxide free air through a solution saturated with carbon dioxide removed a sufficient proportion of the carbon dioxide in twenty minutes to permit the production of deposits substantially crack-free. Continuation of the treatment for one and one-half hours removed all but the last traces of carbon dioxide. This particular test was carried out at a pH of 5.8. Reduction of the pH and increase in solution temperature would, of course, have facilitated the removal to an even greater degree.

Considerable thought has been given to the development of an explanation for the mechanism by which carbon dioxide influences the ductility of nickel deposits. Several hypotheses have been suggested, all of which seem to warrant consideration. One hypothesis considers the possible effect of carbonate, or perhaps of bicarbonate ions on the pH at which basic nickel salts precipitate. This effect would, of course, make possible the production of brittle deposits. A second hypothesis requires the reduction of carbon dioxide to the monoxide at the cathode. A third theory involves the formation of formic acid or formaldehyde by reaction with nascent hydrogen at the cathode. A fourth consideration is the possibility of the reduction of the carbon dioxide with the formation of nickel carbonyl.

To test the first of these theories, that of change in the pH required for basic nickel salt precipitation, specimens of both zinc and brass were plated in a solution containing 0.4 gram of sodium carbonate per liter of plating solution at a pH of 5.45. Edge cracking was apparent on all specimens. The pH of the solution was then reduced to 3.2 which was considered sufficiently low to prevent basic salt formation at the cathode. Specimens plated at

this pH, however, showed edge cracking regardless of which basis metal was used.

This experiment was not entirely conclusive. There is some evidence that the hardness of nickel deposits produced in the sodium sulphate type of solution increases as the pH is decreased. It is possible, therefore, that the cracking at the higher pH which was a direct result of the presence of carbon dioxide, might at the lower pH have been the result of the solution acidity.

Another set of tests, however, gave somewhat more conclusive evidence that basic salt precipitation is not the governing factor. Measurements were made of the pH at which precipitated basic salts made their appearance in the presence and in the absence of dissolved sodium carbonate. These tests were made by adding a sodium hydroxide solution drop by drop to 50 cc. of nickel plating solution until the first trace of basic nickel salt which would not redissolve on standing was noted. The pH of the solution was then measured with quinhydrone electrode. In the pure nickel solution, basic salts made their appearance at a pH of 6.95. In the presence of 0.4 gram per liter of sodium carbonate the salts appeared at a pH of 6.89. The slight apparent lowering of the pH required for basic salt precipitation is probably within the experimental error which existed in the pH measurement.

It is not believed to be probable that carbon monoxide can be produced by cathode reaction of hydrogen with carbon dioxide. The reaction should result in the production of formic acid by the addition of hydrogen to the carbon dioxide rather than in the removal of oxygen to form the monoxide. M. Knobel[2], for instance, reports the use of porous electrodes of various metals in the reduction of carbon dioxide to formic acid. No reference could be found in the literature in which the cathode reduction of carbon dioxide to the monoxide is stated.

To investigate these two possibilities further, tests were made in which formic acid and formaldehyde were added separately to pure nickel plating solutions in quantities sufficient to exceed the equivalent threshold carbon dioxide values. In neither case were cracked electrodeposits produced. Apparently then, any formic acid or formaldehyde produced at the cathode may be considered as relatively harmless to the ductility of the deposit.

To investigate the influence of carbon monoxide, a test was run

2. *Industrial Engineering Chemistry*, Volume 17, page 826 (1925).

in which this gas, generated by the reaction between formic acid and hot phosphoric acid, was bubbled through a 50 per cent sodium hydroxide solution to remove any carbon dioxide and then through a nickel plating solution for thirty seconds to saturate the latter with this gas. Deposits produced immediately after this procedure were found to be exceptionally bright and covered with a fine network of cracks. The solution was then allowed to stand overnight after which specimens plated under the same controlled conditions were found to be normal in appearance and free from edge cracks. These results were confirmed by a check run in which the same bright cracked deposits were noted from the solution saturated with carbon monoxide and the normal crack-free deposits were obtained after standing overnight.

These results demonstrate quite clearly that carbon monoxide is capable of creating brittle deposits from solutions in which it is present. The ease with which the carbon monoxide escaped from the plating solution on simple standing suggests that this gas is not in itself a direct source of trouble in commercial plating operations. The fact, however, that the more probable reaction products, formic acid and formaldehyde, produced no embrittlement of the nickel coatings while the monoxide did suggest the strong possibility that the cathode reaction takes the direction of reduction of the carbon dioxide by the removal of oxygen.

Two articles have been found in the literature which confirm the presence of carbon monoxide in nickel. Guillet and Roux[3] mention that commercial nickel wire heated in vacuum for two hours at 950° gave off twenty-two times its own volume of gas of the following composition:

CO_2	5.5 Per Cent
CO	32.6 " "
H_2	35.7 " "
$N2$	26.2 " "

Villachon and Chaudron[4] refer to the evolution of carbon monoxide from electrolytic nickel remelted in vacuum. In neither case is reference made to the influence of the monoxide on the properties of nickel.

There seems to be some possibility that carbon dioxide might

3. *Revue de Metallurgie*, 26, 1 (1929).
4. *Comp. Rend.* 189, 324, (1929).

be reduced with the formation of nickel carbonyl. The Mond Nickel Company in a private communication obtained through the courtesy of Dr. W. A. Wesley of The International Nickel Company, report that nickel carbonyl is formed and carried over with the gas when a solution containing 5 grams of nickel sulphate and 15 grams of nickel ammonium sulphate in 200 cc. of water saturated with carbon monoxide gas is electrolyzed overnight with nickel electrodes. They were not certain at which electrode the nickel carbonyl was formed but in their opinion it was most probably formed at the cathode.

The mechanism by which carbon dioxide is able to embrittle nickel deposits cannot be clearly stated from these experiments. There is evidence given above that the presence of carbon dioxide does not seriously alter the pH at which basic salts precipitate. There is also evidence that any reduction product of the formic acid-formaldehyde type will not produce the embrittlement noted. While no evidence is presented to establish that carbon dioxide can be partially reduced by the removal of oxygen in a cathode reaction with hydrogen, there seems to be considerable cause for belief that the mechanism takes this particular path. Two references are cited in which the presence of carbon monoxide in nickel has been established and tests are described in which the ability of the monoxide to embrittle nickel deposits is shown. While the carbonyl theory seems somewhat far-fetched, there is some slight evidence in that direction which cannot be entirely disregarded.

PART II.

The second part of this paper deals with a preliminary study of the crystal orientations assumed in a number of deposits whose ductility characteristics were fairly well known. While the results are not sufficiently comprehensive to permit the formation of broad conclusions with regard to the relation of orientation to ductility, they do strongly suggest some such connection. The presentation of this work at this time is made in the hope that it will stimulate further work along these lines and create an interest on the part of the physical metallurgist in the problems of electrodeposition.

The series of coatings listed in Table 3 were prepared for this

work. It will be noted that two separate solutions were used; one of the high sodium sulphate type commonly used in plating nickel on zinc and the other of the sodium sulphate free type commonly used on brass and steel. Variations in thickness and, to some extent, in current density were made.

Table 3

Orientation Anisotropy of Various Nickel Deposits on Rolled Zinc and Rolled Brass

No.	*Bath Used*	*Current Density Amp./Sq. Ft.*	*Base Metal*	*Thickness-Inch*	*Preferred Orientation*
5116	4**	40	Brass	0.0005	(100) Weak
5117	4	15	Brass	0.0005	(100) Moderate
5174*	4	40	Brass	0.0005	Random
5175*	4	15	Brass	0.0005	(100) Weak
5115	2***	15	Brass	0.0005	(110) Moderate
5173*	2	15	Brass	0.0005	(110) Moderate
5166	2	15	Brass	0.0002	(110) Moderate
5167	2	15	Brass	0.0004	(110) Mod. strong
5168	2	15	Brass	0.0006	(110) Strong
5169	2	15	Brass	0.0008	(110) Strong
5170	2	15	Brass	0.0010	(110) Strong
5171	2	15	Zinc	0.0004	(110) Mod. strong
5172	2	15	Zinc	0.0008	(110) Mod. strong

* These coatings were stripped from the brass backing and examined in foil form in a plane parallel to the surface.

** Nickel sulphate.....20 Ounces per gallon
Ammonium chloride..... 4 Ounces per gallon
Boric acid..... 4 Ounces per gallon

***Same as solution used in Part I—see page 185. Operated at 25° C.

The coatings produced in the two-ounce solution are normally somewhat lacking in ductility particularly as the coating thickness is increased. The deposits from the warm four-ounce solution are normally soft and ductile. The comparison between the two types of coating should therefore be quite instructive.

It will be impossible in a paper of this scope to adequately describe the X-ray technique used. It should suffice to say that molybednum X-radiation was diffracted from the unbuffed plated surface at a grazing angle of 10°, the diffracted X-radiation being recorded on a photographic film in accordance with the usual technique in such studies. A few studies were made of the orientation around a normal to the plated surface by means of transmission patterns of plated foil separated from the basis metal.

Two distinctly different orientations were found in the diffraction studies. In the case of the coatings from the four-ounce solution, a weakly developed preferred orientation was noted in which

the 100 plane, or cube face, lay in the surface of the deposit. Variations in current density with the same thickness of coating produced only minor variations in the degree of preference recorded. The coatings from the two-ounce solution showed a much more strongly developed orientation in which the 110 or dodecahedral plane lay in the plane of the surface of the deposit. The intensity of the preference in orientation increased as the thickness of coating increased. It was noted that where a coating 0.0008″ in thickness was produced on both rolled brass and rolled zinc, the degree of preference was more strongly marked in the coating deposited on the brass.

Nickel, having a face centered cubic lattice, deforms by slip on the 111 or octohedral planes. When the 100 plane, or cube face, is in the surface of the deposit, any deformation which tends to contract and thicken the deposit or which tends to extend and thin the coating will be facilitated by the fact that the 111 slip planes are properly oriented to produce the most easy deformation. When, however, the 110 or dodecahedral plane is in the surface of the specimen, the 111 slip planes are poorly oriented relative to the forces of deformation. It is to be expected, therefore, that the latter orientation will be noticeably less ductile than the former, which is consistent with the known characteristics of the deposits.

The transmission patterns taken at a normal to the plated surface indicated completely random orientation about the normal, the preferred orientation existing only in the plane parallel to the surface.

It is not the intention of this paper to suggest that orientation alone controls the ductility of nickel deposits. Internal stress, the codeposition of basic salts and other nonmetallic inclusions, grain size and other factors may, under certain circumstances, have a greater influence than that of crystal orientation. It seems logical to believe, however, that further studies of plated deposits by the use of the X-ray and other tools of the physical metallurgist can be expected to add greatly to the knowledge of the electroplater.

The writer takes pleasure in acknowledging the contributions to these studies of Messrs. C. E. Reinhard, E. J. Wilhelm and M.L. Fuller. The actual experimental work was carried out by these men under the writer's supervision.

A Review *of the* Electroplating Research *at Indiana University*

By FRANK C. MATHERS
Professor of Chemistry,
Bloomington, Indiana

Read at Cleveland 1936 Convention

INTRODUCTION

I WISH to discuss some the of research work done at Indiana University in the field of electroplating. I hope that you will consider that I am merely spokesman for the many splendid students who have done all of these things. The credit for these various researches is theirs. Very little of it could have been accomplished without their efforts. Since they cannot be present, I shall hastily report for them.

The work has been largely in the field of addition agents for plating baths whereby smoother, denser, less crystalline and brighter deposits can be produced. New and novel things have been attempted rather than the mere collecting of data regarding known things or the careful testing of previously described inventions. Most of the work has been published in the transactions of the American Electrochemical Society to which interested persons are referred for more complete details.

GENERAL DISCUSSION OF ADDITION AGENTS AND THE CHARACTER OF DEPOSITS

Some metals have the inherent characteristic property of depositing from most neutral or acid baths in a dense, smooth, and slightly crystalline form while other metals tend to deposit only in a rough crystalline condition. The order of increasing roughness from acid solutions is somewhat as follows:

Bismuth, tellurium, copper, nickel, antimony, cadmium, zinc, lead, silver, and tin.

No explanation is known for these inherent tendencies for smoothness or for roughness. No theory regarding this variation has ever been formulated. These rough crystalline cathode formations can be prevented in most cases by the use of a suitable addi-

tion agent combined with a suitable composition of the bath. These addition agents are organic materials, and, in most cases, only small quantities are needed but the amount and kind vary with the different metals and with the different acid ions. A satisfactory addition agent for one metal and bath may or may not be equally good for another metal or for the same metal with another acid ion. There is no principle or rule, and the invention of improvements depends upon experimental tests. The addition agent is deposited with the metal on the cathode plate and must be renewed in the bath regularly.

Some metals are very sensitive to addition agents. For example, antimony responds to almost every kind of organic substance, whereas tin in a chloride bath is sensitive to none. Silver in a nitrate bath is not very sensitive. No reason for this variation is known. One theory is that the addition agent combines with and becomes a part of the cation. Hence, the ion that comes to the cathode is different from the ion in a bath without an addition agent. Therefore, the character of the cathode deposit should be changed by the addition agent. Metals that are very sensitive are supposed to make combinations easily with many different kinds of organic addition agents.

Many examples could be given showing the effect of the acid ion or the anion upon the cathode deposits. Excellent tin deposits are possible from the sulfate bath with glue and cresol, but only very crystalline deposits can be obtained from the chloride bath with these or with any other addition agents. The best tin deposits are obtained from the fluoborate bath, while deposits from the fluoride bath are not as good as those from the sulfate. Again the explanation is based upon the possibility of the formation of complex cations in which the acid ion and the addition agent are both present. Such complex cations are set free on the cathode and build up the deposit. This explains the presence of the addition agent and of small quantities of the acid ion in the cathode deposit. For example, the bismuth cathodes from the perchlorate bath contained .43% of perchlorate. Iodide and chloride have been found present in most metals deposited from those solutions. Therefore, since the cathodes contain some of the acid ion, it is perfectly logical to conclude that the acid ion should have an influence upon the character of the deposit. There is no other good way of explaining the presence of the acid ion in the cathode

deposit except to assume that the cations are complexes containing some acid ion. Also in the same way this theory accounts for the fact that an addition agent may be satisfactory with one salt of a metal and not with a different salt of the same metal. The presence of the particular acid ion may be necessary for the formation of the essential complex ion. For example, glue is not suitable for lead perchlorate, although it is perfectly satisfactory for the lead fluosilicate bath.

TIN

When work was started upon tin plating, the bath made from tin oxalate and ammonium oxalate was recommended as the best. Only a mass of projecting crystals could be obtained from it. The deposits were worthless either for ornamental or protective purposes.

The addition of peptone[1] restrained the crystals and gave quite satisfactory, smooth, heavy deposits. However the oxalate baths generally deteriorated during use and finally had to be discarded.

All the experiments at that time failed to show any addition agent that was satisfactory for a sulfate bath. Enthusiasm for continued work was fostered by the firm conviction that there must be some addition agent which would restrain the crystalline structure in a bath made from any ordinary salt of tin. Finally the use of a mixture of glue and cresol[2] was accidentally discovered. No addition agents have ever been found that equal these. The quantities required can be varied through rather wide limits but .5 gm. of glue and 10 drops of cresol per 100 cc. (.7 oz. of glue and .7 oz. of cresol per gal.) will give quite satisfactory results after the bath has been operated a day or two to attain equilibrium. Larger quantities of the addition agents give better deposits than do smaller quantities. Various glues, used in large quantities differ in the tendency to cause quite vigorous hydrogen evolution at the cathode for a while. Any tin salt, except the chloride, can be used. The concentration of the bath should be about 15 gms/100 cc. (20 gms/gal) of stannous sulfate and 2-3 gms/100 cc. (3-4 gms/gal) of sulfuric acid. A current of 3 amp./dm^2 (27 amp./ft^2) can be used. The anodes dissolve without difficulty and the bath is easily maintained. These addition agents were used for several years in tin refining by the American Smelting and Refining Company at Maurer, New Jersey.

This bath does not have as good throwing power as the sodium stannate bath, but the latter bath will not give as thick smooth deposits as the sulfate bath.

Recent patents cover the use of sulfonated cresols in tin plating. Experiments by this author show that sulfonation largely destroys the activity of the cresol.

Excellent deposits of tin were obtained from the stannate bath with selenium[3] as an addition agent, but no way of maintaining the bath was found, hence this work was dropped.

Balsam of copai ba[4] was found to be a valuable addition agent in the stannate bath.

Several methods of making stannous sulfate for preparing the plating baths were devised and published.[5]

New addition agents are still being tried on the tin chloride bath, but, so far, only masses of crystals have been produced. There may be no addition agent for a tin bath containing chloride, but I think we have merely failed to find the right thing.

ALUMINUM

Aluminum completely baffled all attempts at electrodeposition, because it is so active that it cannot be deposited from any bath containing water. At last, after about three years of work, a successful bath[6] was prepared from aluminum bromide, aluminum chloride, ethyl bromide, and benzene and xylene. All of these materials must be free from water, and the bath must be kept covered as completely as possible to avoid absorption of moisture from the air. This bath is quite different from other non-aqueous plating baths in that it has a rather low electrical resistance, has a fairly good throwing power, gives a good deposit, and has good anode corrosion. It is doubtful if this bath can ever be used for any but special small articles where a somewhat large cost is not serious.

A rather detailed description of a method of preparing a bath for this aluminum plating is as follows. Anhydrous aluminum bromide — 20 grams, anhydrous aluminum chloride — 20 grams, benzene — 100 cc., xylene—50 cc., ethyl bromide—40 cc., and metallic aluminum—8 grams are needed or in this proportion. The above amounts will give 120 cc. of plating solution with a benzene protecting layer of 30 cc. The above ratio in ounces

instead of grams and cc. will be sufficiently exact. The benzene and xylene should be dried with phosphorous pentoxide, filtered, and distilled. The ethyl bromide should be dried with calcium chloride and distilled. The anhydrous aluminum bromide may be prepared by carefully dropping small pieces of aluminum into bromine. The reaction can be carried on in an Erlenmeyer flask equipped with a reflux condenser. The flask should be cooled in a water bath. The flask should be connected to the condenser with a ground glass joint. After the aluminum bromide has been prepared the aluminum chloride is added and the two salts heated until they are completely fused. After cooling to room temperature, the benzene and xylene are added and the flask is heated gently until the aluminum salts have completely dissolved. The ethyl bromide is then added in small portions at a time so that the temperature does not rise about 60° C. The solution is then allowed to cool and transferred to the electrolyzing cell. The current density should be about 15 amp./ft.^{2} (1.6 amp./dec.2).

Quite wide variations in the composition, the method of making, and the conditions of operation are possible without interfering with the satisfactory results. Moisture or water in the bath is the most serious trouble.

This research and that of tin with cresol and glue should be listed as the two most important ones ever done in plating at Indiana University.

ANTIMONY

Very little antimony plating has been done, but there is no difficulty in the process. Antimony fluoride in hydrofluoric acid is entirely satisfactory[7] This bath, without an addition agent, gives solid and firm but roughly crystalline deposits. Many different addition agents will prevent the formation of the rough crystals and make very smooth deposits. Antimony is perhaps the most sensitive of all the metals to the greatest number of addition agents. Aloin, .025 gms. per 100 cc. (.033 oz. per gal.), twice daily, is one of the most satisfactory addition agents. A trace of clove oil, .0025 cc. per 100 cc. (.0033 oz./gal.), makes the deposit still smoother and more glossy. Too much of the addition agents will cause the deposit to curl and break away from the

cathode. Practically all organic substances that will dissolve in the bath have a beneficial action. Antimony deposits are brittle; hence uses for them will be very limited.

TELLURIUM

Tellurium[8] can be deposited in excellent condition from a solution of tellurium fluoride and hydrofluoric acid. The deposits are excellent without any addition agents. Tellurium is so sensitive to addition agents that more than .005 gms. per 100 cc. (.0066 oz./gal.) of glue, roughens the deposits. If enough glue is present, the deposits curl and break from the cathode. A very small quantity of glue makes the deposits a little more glossy or shiny. Unfortunately, lead seems to be the only base metal on which the tellurium can be plated, and even then some sulfuric acid must be added to the bath to reduce primary action. Cathodes or objects of other metals, on open circuit, deposit non-adherent powdery tellurium which prevents the electrodeposed metal from adhering.

MAGNESIUM

Magnesium, which is more active than aluminum and therefore more difficult to deposit, can be plated[9] from Grignard's reagent, a nonaqueous liquid. The deposit is quite crystalline and the bath deteriorates very rapidly. No way is known of preventing either of these troubles. No possible use for magnesium plating is known.

BISMUTH

Bismuth[10] has never been electroplated in a smooth solid form except from the perchloric acid solution of bismuth perchlorate. Bismuth is peculiar in that most of its salts react with water and produce precipitates. Bismuth perchlorate is unusual in that it gives a clear solution in water if only a little free perchloric acid is present. Such a solution is ready for electroplating. Addition agents are entirely unnecessary for the formation of smooth, glossy deposits. Bismuth is brittle; hence, any use in plating must be limited to rigid articles.

LEAD

Much work was done upon lead plating from lead perchlorate baths[11]. Peptone and clove oil were found to be excellent addition

agents. Perchloric acid has never been cheap enough for commercial use in plating, but numerous references by various writers say the best lead deposits are obtained from this bath.

Quite good deposits of lead can be obtained from solutions that are mostly lead acetate[15], and lead formate[13], and lead lactate[14], and lead nitrate[14]. However, no special advantages were noted for these baths.

Excellent lead deposits can be obtained from baths of lead dithionate and free dithionic acid[16]. In general, glue along with aromatic hydroxy bodies such as phenol, B-naphthol, resorcinol etc., are the best addition agents. For example, .005% B-naphthol and .005% glue will make the deposit smooth and firm.

The use of rosin in sodium hydroxide solutions of lead salts (sodium plumbite) was first suggested[17] from this laboratory.

NICKEL

Nickel plating experiments showed the value of small quantities of sodium citrate as a solvent for iron sludge whereby the nickel baths remained much clearer. Also the effect of very small quantities of iron and nitrates in reducing the current yield of nickel on a rapidly rotating cathode was pointed out[18].

Some nickel and cobalt baths[19] with high throwing power were prepared by adding such materials as Rochelle salts, ethanolamine, sodium carbonate, and sodium hydroxide to nickel and cobalt salts. The deposits were never as good as from the ordinary baths, and besides, gradual deterioration of the baths could not be prevented.

SILVER

Silver deposits from the nitrate solution containing nitric acid are very crystalline even when the ordinary addition agents such as glue are used. However, tartaric acid, three per cent, and metaphosphoric acid, one per cent, were found[20] to give solid and firm but brittle deposits.

An additional interesting fact that supports the theory of complex ions is that ferric nitrate added to the bath gave cathodes containing .086 per cent of iron. The deposits were dark in color and were very much smoother from baths containing two per cent of ferric nitrate. The tartaric acid is much better than the metaphosphoric acid.

Other silver salts besides the nitrate were tried,[21] but nothing especially different was discovered and none of the ordinary addition agents gave finely crystalline smooth deposits.

MERCURY

Mercury can be easily deposited from mercurous perchlorate.[22] This salt is similar to bismuth perchlorate in that it does not readily hydrolyze and precipitate in water solutions.

PREVENTION OF SPRAY FROM THE CHROMIUM BATH

The addition of one drop of fish oil[23] for each square inch of surface of the chromium bath forms a layer of foam which prevents most of the spray or "throw out." The more oil, the thicker is the layer of foam, and the more completely is the spray stopped. Whenever the foam becomes insufficiently thick, more oil must be added. This fish or similar oil is very much better than the mineral oils that have been recommended previously. This prevention of spray improves the health conditions and saves the loss of the "throw-out," which has been estimated as equal to the "plate-out."

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Properties of **Fused Alumina Grain** *for Polishing*

A. A. KLEIN

INTRODUCTION

IT IS undoubtedly true that the Polishing Department of the modern industrial plant geared to high production has been among the last to step up in performance to a point comparable to other departments involving such machine tool operations as grinding, lapping, reaming, boring, and so forth. It is probably fair to say that up to recently, polishing with set-up wheels was relatively the most expensive and least efficient of these operations. Unfortunately, this situation still exists in some plants even today. Consequently, more and more attention has been given and is being given to all the factors involved in polishing and the results have been very much worth while.

The step-up in efficiency and improvement in the use of set-up polishing wheels has been made possible by developments in several directions among which may be listed the introduction of the automatic polishing machine, developments in abrasive grain, improvements in the setting up and drying of the wheels.

It is our purpose to confine ourselves entirely to a consideration of improvements in abrasive grain — what they are and how they are maintained.

In a set-up wheel head, as with a grinding wheel, it is necessary that the most suitable grain be chosen, that such grain be held most firmly by the adhesive which is generally glue, and that the spacing of grain, glue, and intervening pores — that is, the structure of the wheel head — be such as to give the most efficient action under conditions of use. Laboratory tests and field experience both have shown that to meet the conditions, several requirements are essential in the abrasive grain.

CHEMICAL COMPOSITION AND CRYSTAL STRUCTURE

The chemical composition and crystal structure determine the inherent hardness and strength properties of an abrasive. By far

the most important abrasive used in polishing is a fused alumina of approximately the following chemical composition:

SiO_2	(silica)	1.50%
Fe_2O_3	(ferric oxide)	0.50
TiO_2	(titania)	3.00
Al_2O_3	(alumina)	95.00(by difference)

A lump of such an abrasive is dense, brown in color, with a resinous luster and a conchoidal fracture. No evidence of cleavage or parting planes are present.

When examined under the microscope, this abrasive is found to be made up of about 95 per cent of synthetic corundum (the alpha form of alumina), the remainder being a non-crystalline slag and glass in the form of stringers, irregular patches and rounded globules. Characteristic for this abrasive is its crystal structure. The alumina crystals are large, dense, and lacking in cleavage. The slag and glass lie essentially within the crystals in particles separated from each other. Because of its coarse crystallinity, all individual grains in any size, used for polishing, are each composed of a part of only one crystal. By laboratory tests as well as field experience, this material is the strongest and toughest commercial aluminous abrasive available.

In the manufacture of this product a careful chemical control is exercised on the raw materials as well as on the finished abrasive; this, in addition to a careful inspection of the latter for crystal structure.

PARTICLE SIZE

At a symposium held quite recently on control of particle size by the American Society for Testing Materials, which was followed by a consideration of screen specifications, it was agreed that the requirements of the abrasive industry were so stringent in comparison with other industries, as to place these requirements in a class by itself. Such a statement is particularly interesting when it is considered that not very long ago the inspection for sizing of abrasive grain was a matter of judgment on the part of an individual as to whether the products being inspected matched the respective reference samples set up as standards for size. The comparison was made visually in the coarse sizes and

microscopically in the finer sizes. Obviously such methods were open to the limitations of the human equation.

The change to a mechanical method was by no means easy since in the first place it involved a consideration of the variability in screen apertures and the accuracy to which they could be woven. Even now with all the improvements and progress that have been made, the surest way to determine whether a screen has the proper specification is to sieve through it a standard sample whose analysis is known.

During the 1930-1931 the Abrasive Grain Industry employed for nearly a year a full-time research associate at the Bureau of Standards to study test sieves, technique of sieving including calibration and establishing master grain standards. Much valuable information was developed and as a result of this work, the Industry now has at Washington a set of master reference test sieves for use by members in checking working test sieves in cases of dispute. Today there is a sizing agreement among the abrasive grain producers which, while not one hundred per cent perfect, is nevertheless a great improvement over conditions existing a few years ago.

The following tabulation gives the most recent specifications now in use.

Grit No.	Minimum of 100% through Screen	Control Screen Opening No.	Control Screen Opening in Inches	Maximum Oversize on control	Minimum of		Cumulative Minimum of		Maximum of 1% Through
36	20	30	.0232	15%	60% on	35	85%	on 35 & 40	45
46	30	40	.0165	15	60	45	85	45 & 50	60
54	35	45	.0138	15	60	50	85	50 & 60	70
60	40	50	.0117	25	60	60	75	60 & 70	80
70	50	60	.0098	15	60	70	80	70 & 80	100
80	60	70	.0083	15	55	80	80	80 & 100	120
90	70	80	.0070	15	55	100	80	100 & 120	140
100	80	100	.0059	15	55	120	75	120 & 140	200
120	100	120	.0049	15	45	140	70	140 & 170	230
150	100	140	.0041	15	50% on	170 & 200	85	170,200,230	270
180	120	170	.0035	15	20	200 & 230	75	200,230,270	
220	140	200	.0029	15	50	230,270	70	230,270,325	

METHOD OF TEST

The screens referred to above are those of the U.S. standard series certified by the U.S. Bureau of Standards or equivalent. 100 gm. are shaken five minutes on a suitable testing machine.

In making proper use of these specifications several facts must be borne in mind. First, screens which are certified by the Bureau of Standards do not necessarily give identical sieving values for the same material. Secondly, screens do not remain constant in use since there is a definite tendency for apertures to become larger and more variable before holes or tears actually become evident. Finally, different testing machines may give varying sieving values for the same grain sample on the same screens. Because of these limitations it is recommended to the larger users of abrasive grain who have provided themselves with means of applying these specifications that for reference use they secure from the manufacturer samples meeting their own polishing requirements and agreed upon by both parties as passing the specifications. In cases of dispute, for instance, these samples should be referred to and should distinguish between variability of product for which the manufacturer is responsible and variability in screening conditions on the part of the user.

CAPILLARITY

Capillarity is that property which determines the ease and ability of wetting of abrasive grain surfaces by a glue solution and is measured by the height to which abrasive grain in a hollow glass tube will draw up water from below against the force of gravity during a given time. This property is a function of the cleanliness of grain surfaces since the presence of oil or grease films tend to repel the water or glue solution, thus preventing them from properly wetting the grain surfaces. Field experience without exception indicates that a loss of capillarity, generally due to poor storage conditions of the keg after opening or of improper procedure in handling the grain in the set-up trough, seriously impairs the grip or bonding strength between the glue and the abrasive. Wheels set up with grain of low capillarity will likely shed the grain during polishing and so give a poor performance because of short life.

Laboratory tests measuring briquette tensile strength of glue bonded grain made and tested under carefully controlled conditions have clearly indicated the undesirable effect of grain of low capillarity as shown in the following tabulation.

Abrasive	*Capillarity*	*Tensile Strength in Lbs./sq. in.*
#36 abrasive C	7.4 cm.	1120
"	1.8	662
#36 abrasive B	7.0	910
"	1.9	540
#80 abrasive C	1.90	1230
"	4.0	486

SHAPE OF GRAIN

Not very many years ago the matter of external grain shape was practically uncontrolled in the manufacture of abrasive grain. Such products were made according to one or more milling procedures and even these might or might not be rigidly adhered to. That this resulted in a large variation in grain shape is readily understood. Now we know that by adopting the proper milling steps, the shape of grain can be controlled and varied as desired.

It is no exaggeration to state that if industrial requirements made it necessary, it would be possible, starting with the same crude abrasive in the lump form, to produce at one extreme grains which approached spherical forms and at the other extreme those consisting essentially of flakes and slivers. As a matter of fact however, the requirements are met by two shapes of grain, one which is blocky or chunky and consists of irregular, equidimensional grains as well as thick wedges.

The other while containing a predominant amount of chunky grain, shows also a notable percentage of thinner wedges, flat and elongated grain.

It may be interesting to observe that for use on sandpaper a third shape is required. Here the grains are composed essentially of thin wedges, flakes, and elongated grain.

Several inspection test methods have been used to insure the uniformity of shape and to make certain that the grain has the required shape. One such test depends upon the fact that the bulking weight of grain carried out under comparable conditions depends upon the factor of shape. Chunky equidemensional grain give greater bulking weights than thin wedges, flats, and elongated grain.

ADHESION OF GRAIN TO GLUE

The question of treating the surface of grain to specifically produce a greater bonding strength between it and glue has, within

the last few years, been extremely active with the manufacturers of electric furnace abrasives. Previously, the purpose of this step of manufacture was, as has been stated previously, merely to remove the infinitesimal oily film which was held responsible for low capillarity. The removal of the film was accomplished either through the detergent action of an alkaline solution or through the volatilization of the film by heat. Grain treated by these methods still finds many very useful applications in polishing, particularly in the finer sizes (# 100 and finer).

For the coarser, rougher operations, and particularly for high production requirements, it has been found necessary to considerably improve the grip with which the glue holds the abrasive by treatments which give etched coatings on the grain surfaces. The abrasive grain is first coated with suitable chemicals and then heated at temperatures sufficient to cause a chemical reaction at the surface of the alumina crystals, which results in their being etched.

Such products are composed of grain which have lost their original bright luster and appear dull, roughened, and more or less dusty. A comparison will illustrate the difference, particularly in surface roughness, between unetched and etched coated grain.

It must be observed at this point that a considerable difference in polishing performance and characteristics of wheel heads is possible when they are set up with various etched coated grain depending upon several factors, chief of which are the chemical composition of the coating, the heat treatment employed, and the uniformity of the coating around the grain surfaces.

For instance, two etched coated products which we shall designate as abrasives C and M, are unlike in chemical composition of coating and temperature application. They produce wheel heads which fit them to give the best polishing results under entirely different field conditions.

Wheels set up with abrasive C have the hardest acting heads and find best application where the metal is less sensitive to heat and where the work tends to dress the wheel due to thin contacts, projecting corners, and edges. On the other hand, heads set up

with abrasive C must be properly dried else they tend to glaze, which results in burning or checking the work.

Abrasive M produces heads which have a faster cut, and at the same time a high efficiency with less tendency to burn the work. This abrasive is particularly adapted to flat work where the dressing action of the metal is not serious, and to conditions where the wheels tend to burn and check the work.

The increase of strength of an etched coated grain versus the same grain unetched is shown in the following tabulation of tensile strength briquette tests of # 36 grain bonded with glue and made to several controlled structures.

Volume %		*Tensile Strength in lbs./sq. in.*		*%Strength*
Abras.	*Glue*	*Abrasive B Unetched*	*Abrasive C Etched Coating*	*Increase of C over B*
53	4	675	871	28
53	10	1363	1710	25
67	4	1010	1210	20
67	10	2170	2620	21

The greater adhesion of glue to abrasive C is related to the etched coating, but the cause or causes for it are not entirely known. It may be the greater surface exposed to the glue by the "hill and valley" effect of the coating. It may be the greater absorption of glue by the coating; or it may be a strengthening of the glue bond posts by the presence of an extremely slight amount of alkali contributed by the coating.

It must be emphasized that the unprepossessing appearance, including the dusty nature of etched coated grain such as abrasive C or M, is of no consequence since it has no adverse effect on capillarity and adhesive strength, and does not impair the efficiency of the abrasive in polishing.

In conclusion it may be stated that the purpose of this paper has been to present rather briefly the status of fused alumina polishing grain as it is made today. It is evident that improvements in quality have taken place throughout all the steps in the preparation of the grain, beginning with the fusion of the abrasive in the electric furnace. These improvements, together with the development of tests to maintain them uniformly, have served their role and borne their burden in making possible the ever-increasing efficiency of operation in the polishing room. It is to be expected that progress in the future will not be found wanting.

Plating *of* Unusual Materials

By DR. S. FISCHER Jr. Ph. D.
Honorary Member of A. E. S.

Read at Los Angeles Annual Meeting March 1937

GENTLEMEN. You know my friends here in Los Angeles have sort of put me on the spot with this talk on plating of unusual materials; but I am going to fool them a bit today. You know more about rare metal plating than I do, I am sure, so I am going to cover a few rare metals as rapidly as I can. I am to give to you the products which I think are opening a new field in electroplating in many respects.

There is a German patent out claiming that Ruthenium can be deposited as a metal. It seems to have a sort of redish-white appearance. It is very good as a deposit. The current density used, I understand is somewhere between 70 and 90 amperes per square foot. The temperature is comparatively low — 25 to 35° c. It is claimed that if you flash rodium on a metal and follow this with ruthenium and repeat this several times the final deposit will be bright instead of dull. It is said that ruthenium is excellent for art deposits and it is felt that ruthenium has a field in jewelry and specialties.

The next metal is tungsten, which is, as you know, the next neighbor to ruthenium. Now I am not going to say much about this, except to tell you that which you already know, namely that tungsten is not attacked by chlorine, as is ruthenium. This, of course, is an advantage and I can see endless uses for tungsten plating. The suggested electrolyte is a concentrated solution of tungsten acid wo_3 in sodium carbonate at 100° C., the current density used varies from about 43 to 100 amperes per sq. ft. It appears that the higher the temperature, the brighter will be the deposit. Tungsten, generally speaking, isn't a very brilliant metal, not very white in color, but the electrolytic deposit is a beautiful silvery finish. This, of course, is due to the molecular condition of the cathode. If I have enough time I may tell you a little more about this molecular condition later on. An interesting thing about tungsten is that one may

plate alloys of tungsten by dissolving tungsten in hydrofluoric acid obtaining a solution of WO_2F to that then is added a salt of the metal with which tungsten is to be alloyed, preferably a fluoride.

Ruthenium is also capable of being deposited as a metal. It gives the desired adherence and a high luster. As to whether another metal could give any better results than rodium does, I cannot say. Of course, all of the platinum group are, as you know, rather expensive. Platinum, ruthenium, and like metals are not used much, perhaps due to cost, yet the protective thickness of these metals is so small that it doesn't take a very large amount of metal to give a satisfactory coating. Furthermore, thallium-zinc, as a combination, can be deposited as a plate from a perchlorate solution of thallium containing zinc nitrate.

But what I am interested in today and what I would like to bring to you, is the matter of anode plating. That, perhaps, we have not gone into far enough, into the oxidizing action of the electric current in terms of electrolytic work.

There is a group of metals, we call them Ampholem metals, which act both as acid and as base or alkali. Often, of course, we are able to get such metal as a metallic cathode product just like tungsten. On the other hand, they furnish us an opportunity of getting more familiarized with oxides. I have done quite a bit of work along this line and the results are at least very interesting. The first time I encountered that work was with vanadium. Vanadium is deposited from a vanate solution under conditions similar to tungsten.

Many metals like tungsten, vanadium, and molybdenum, have series of oxides, these oxides ranging in color all the way from black through browns, yellows, oranges, blues, greens to red. Just think of the possibilities, especially for decorative work. Vanadium, molybdenum, tungsten, and similar metals behave very much alike. The current densities vary anywhere from 40 to 600 amperes per square foot. The temperatures used lie between 60° F. to 212° C. In doing this work a great deal depends upon the efficiency of depositing the oxide, an oxidizing agent such as hydrogen peroxide added to the electrolyte in-

creases the efficiency from 29% to 96%. The amperage, temperature and concentration of metal in electrolyte determine the type of oxide deposit obtained. In working with the anode deposits, it was observed that if the anodes were flashed and heated so as to melt the deposits, the deposits became very adherent. Sometimes they would change in color but upon buffing the color would reappear. It was found that the oxygen content in the electrolyte in terms of oxidizing agent played an important role as to the particular oxide to be deposited, and naturally, this determined the color of the oxide, in part, at least. The vanadium oxides vary from nearly red, through orange, green, blue to lavendar, and all of these oxides may be produced by manipulating current density, oxygen content, temperature, and metal concentration. Considering these things there is a great possibility for anode deposit processes. Another item of interest was observed. A cathode deposit taken out of a concentrated sulphuric acid solution saturated with vanadic acid yielded a green vanadium sulphate. This was an unheard of phenomenon and opened a new field of investigation. The green sulphate, upon dissolving in water, changed to the blue vandyl sulphate. Another effect was observed, the electrolyte could be oxidized to any stage and any stage if salt could be obtained by evaporation. Vanadium, tungsten and molybdenum are open for further investigation. In all processes cathodes and anodes are inseparated by forms partitions. I have been able to produce C.P. oxides, and salts with little difficulty.

Another series of experiments were tried with mixed oxides. Mottled effects on the anode were obtained when oxides deposited under like conditions. When these deposits were fused and then buffed very beautiful results were obtained. It is fortunate that metallic oxides like tungsten, molybdenum and vanadium deposit under similar conditions from similar electrolytes.

There are other fields open for investigation. For instance, in doing some work with aluminum at the time I was associated with Dr. Richards, we insulated aluminum wire with a coating of aluminum oxide. The coatings resulting seemed to be somewhat gelatinous in nature but were subjected to heat treatment and the wires seemed to be insulated and the coating did not

crack. In other words the coating was of such a nature that it was perfect as far as an insulating material was concerned.

Coating molybdenum and tungsten wires with their respective oxides and fusing same into the wires, yielded materials suitable for heating elements, a thing which was impossible, using the metallic wires straight, due to the ease with which they oxidized in hot air.

It appears to me that there are more prospects for oxide coatings than those mentioned, but much work will have to be done.

I would like to speak about rubber deposition but I think our time is somewhat limited. I will therefore, confine myself to essentials only. You all know that rubber is being artificially deposited. A striking feature in this deposition is that the amount of rubber deposited per amperage second is far beyond what one would expect from metals. The reason for that is, that you are not dealing with a true electrolyte, you are dealing with very finely divided emulsion whose latex particles are negatively charged and then you travel to the anode by the process known as cataphoresis. The wonderful part about this particular type of plating is, that the ingredients required for vulcanization may be simultaneously deposited with the Latex, thus obtaining the product to be vulcanized after deposition.

These ingredients finely divided are added to the Latex-ammonia solution plus a sulpho-hydrate or polysulphide. The ingredients and the sulphur formed will, like the rubber, be negatively charged and travel to the anode, depositing simultaneously. P Oxygen is liberated at the anode. This is detrimental to the rubber, making it porous. Some material has to be added to the latex bath which will take up oxygen more readily than will the rubber. Such a substance is Pyhogallol. Another method is to add Amines with a lower discharge voltage than that of the hydroxyl ion OH. Such ions are the sulpho-hydrate HS and the poly-sulphites Sx-. Finally metals may be used as anodes, whose oxides are useful as fillers for rubber, Zinc, cadmium, and magnesium are most suitable. Iron and copper are also suggested, but appear to give less satisfactory

results. Cadmium and iron give undesirable color effects while copper appears to yield cuprous ions which ions are detrimental to a good rubber deposit. It is essential that the rubber particles and the sulphur and the filler particles travel at the same speed to the anode in order to insure a uniform mixture suitable for vulcanization, as an anode deposit.

Beal's Process for rubber deposition uses as an electrolyte 35 percent by weight of rubber and fillers; 20 gram per liter of ammonia, and 30 gram per liter of potassium, sodium and ammonium salts, essentially ammonium chloride. This is placed in the anode compartment, while the cathode compartment contains slightly alkaline water. The anode is either zinc or galvanized iron. Current density 7-24 amperes per square foot, voltage 10-100 volts; temperature, room temperature. It is also possible to deposit rubber and porous forms, which surround the anode. Higher amperages may be used for a short period of time as the resistance offered by the rubber deposit causes the excessive heating of the electrolyte.

Most of these anode products are produced in an anode chamber by use of a porous diaphragm. At times it is essential to add oxidizing agents to increase the efficiency. The range of colors obtainable from the oxides of such metals as tungsten vanadium, molybdenum, tantalium, columbium, chromium, manganese, aluminum etc., is practically complete.

In the oxide work, generally speaking, we have similar conditions to content with these amphoteric elements. The anolytis and actholytis are similar, so are the current densities, the temperatures and the metal concentrations.

I thought while you gentlemen were gathered here I would broach this topic to you, since you are all very much interested in electro-plating.

Perhaps, the possibilities of anode plating might open up a new field of thought and research which as yet has hardly been touched. I thank you.

Testing Bethanized Wire *Coatings*

By E. J. CRUM
Bethlehem Steel Company
Paper Read at December Meeting of Baltimore-Washington Branch

I INTEND to confine my remarks to the zinc coating tests which we have developed or adopted and which are actually in use in controlling the quality and meeting the customers' requirements of Bethanized wire.

Our purpose in testing the zinc coating is twofold: First, to measure relatively the corrosion resistance or life expectancy of the wire; and secondly, to determine the ability of the coated wire to withstand the forming operations which it will be subjected to in subsequent manufacturing processes.

There are two ways of going about estimating the relative resistance of the coating to corrosion. The wire may be subjected to one or another of the familiar accelerated corrosion tests, as the Preece test, the salt spray, intermittent immersion and many others intended to simulate and accelerate the corrosive action of a given atmosphere. Most of these tests require considerable time for completion and results are often difficult to interpret. For this reason they are used only when specified by our customers. Such specifications are becoming increasingly rare because accelerated tests have not proven reliable and because the Preece test cannot be depended upon as a measure of the zinc coating.

Inasmuch as Bethanized wire is furnished in such a variety of coating weights (from .3 oz. to 3 oz. per square foot) and each customer's order is dealt with individually, it is absolutely essential that we have quick and accurate tests for controlling the coating. Because of this necessity and because we are interested in making the highest quality wire, we choose to use the second method of determining the expected life of the wire; namely, the testing of the factors influencing its corrosion resistance. These factors we believe to be:

First, the weight per unit area or the thickness of the zinc coating;

Second, the uniformity of thickness of the coating;

Third, the purity of the zinc coating.

I shall now consider briefly the tests in use in our plant for definitely measuring these controlling factors.

Bethanized wire is made almost entirely on a basis of ounces of zinc per square foot of surface. This is roughly equivalent to an increase in diameter of .003 for each ounce of zinc per square foot or a coating thickness of .0015 per ounce per square foot of surface. This difference in gauge of the bare and coated wire offers a quick and simple method of approximating the weight of coating. The operator, therefore, can roughly set the wire speed for any desired weight of coating by the use of his micrometer. For closer adjustments laboratory tests are made. We have two methods in use for measuring the coating weight.

For accurate determination of the zinc coating we use the laboratory balance for weighing the wire sample before and after stripping the coating in hydrochloric acid. The value for the ounces of zinc per square foot is calculated from the results. This calculation depends upon the method of cutting the sample wire. It is possible to cut the wire, according to its diameter, to a pre-determined length which will make the difference in weight in grams of the coated and uncoated wire numerically equal to the ounces per square foot of coating. If an unknown length of wire is used in the strip test, the coating in ounces per square foot is calculated by a formula involving the density of steel. For extreme accuracy about 10 cc of 10% antimony chloride is added to the stripping acid to retard the action of the acid on the steel.

If the desired accuracy is not greater than $\pm 5\%$ the method described in the ASTM Specification No. A-90 is admirable. In this test a measured length of wire, cut according to its diameter to produce a constant surface area, is stripped of its coating in a measured volume of hydrochloric acid. The rise in temperature of the mass of acid is measured with a Fahrenheit thermometer graduated in tenths of degrees. The weight of coating is found from a standard table. The entire test can be performed in less than three minutes and the results are quite reliable.

The next important factor determining the life of wire, I have stated to be uniformity of coating. By this I mean that an even thickness of zinc both around and along the wire is most

desirable. Analogous to the proverbial chain, the life of the wire is no longer than its thinnest coating. Fortunately in zinc coating round wire by means of our electrolytic process, the electrolyte (which is the only source of zinc supply to the system) completely surrounds the wire and the current distribution is naturally uniform; hence the coating distribution is very nearly perfect. Unfortunately so far, there is no real good test for determining the uniformity of coating. At present the Preece test is being used for this purpose, but, as brought out by studies conducted at the Bureau of Standards, this method is by no means all that is desired.

The third influential factor named was purity of the zinc coating. We are extremely interested in keeping our zinc deposit as pure as is practically possible to do so. To do this, test plates of zinc on aluminum cathodes are made at regular intervals from the electrolyte. These plates are made at low current densities (100 A/sq.ft. as compared to average of 1200 A/sq.ft. on the wire). They are examined for surface conditions, character of deposit, density, and physical qualities. Deposits made at low current densities appear to reflect the influence of the character of the electrolyte upon the physical characteristics of the zinc more than similar deposits made at higher current densities. These tests are in addition to the chemical control tests on the electrolyte and leaching process. The leaching process works over and purifies continuously our entire volume of electrolyte. This process, as contrasted with the usual soluble anode method of plating, allows us to plate zinc of extreme purity.

An interesting demonstration of the effect of impurities in the zinc coating can be made by dipping a piece of hot galvanized wire and a piece of Bethanized wire in a 5% solution of H_2SO_4. Pure zinc, I am speaking of four nine and five nine purity, has only a slight solubility in sulphuric acid. However, if any impurities are present in the coating either from the zinc or from the zinc-iron alloy formed, a galvanic couple is set up and the zinc dissolves in preference to the impurity. This very reaction occurs in the case of hot dipped galvanized wire where impurities are always present due to the alloying action of the hot spelter. Hydrogen bubbles can be seen rising from the surface of the hot dipped wire, at first slowly, and later

quite vigorously. After the coating of the hot dipped wire has been completely dissolved, examination of the Bethanized wire in the same solution proves that the coating is practically unattacked. This test is used to identify Bethanized wire.

The second reason for testing Bethanized coatings, as stated before, is to determine the ability of the wire to withstand the severe forming operations which will be required of it in manufacturing wire products. This is also accomplished by actual forming tests and tests for the factors influencing the resistance of the coating to severe forming.

The most common of the actual forming tests consist of: the mandrel tests, the most severe of which requires the wire to be wrapped around its own diameter; the brush handle twist test requiring a definite number of turns per lineal foot; and the 180° bend test. After these tests have been made, the coating is critically examined for any signs of flaking, powdering, peeling or any failure which might indicate a lack of ability of the coating to withstand the most severe deformation incident to the fabrication of the wire into the final products.

The factors controlling the resistance to forming we believe to be:

1. *The ductility of the zinc coating.*
2. *The bond of the zinc to the steel.*

Ductile zinc to us means pure zinc. Once again the properties of pure and impure zinc are totally different in that impure zinc is quite brittle and pure zinc is so ductile that it can be drawn and rolled into very thin gauges. Not only are our wire coatings tested, but actual ductility measurements are made by the Ericksen machine on the periodic test plates, previously referred to.

The bond of the zinc to the steel is tested by the wrap and bend tests.

In all of the above tests and operations, careful supervision is, of course, an essential factor.

Charles F. L. L'Hommedieu

Chas. F. L'Hommedieu, 93 years old, founder of the plating and polishing concern bearing his name, died March 19, at his home in Los Angeles, Cal.

He was born in Stockbridge, Mass., a descendant of Benjamin L'Hommedieu, a French Hugenot who settled in the United States in 1686. He came to Chicago in 1898 and established the firm of Chas. F. L'Hommedieu & Sons Company.

He retired from this business fifteen years ago and went to Los Angeles to live. Funeral services were held in Los Angeles.

Here and There

The regular meeting of Hartford Branch was held on Monday evening, April 19. Mr. Conradi, Research Director of International Business Machines and member of Binghamton Branch was present and gave a short address. Mr. Conradi visited several industrial plants in Hartford, Waterbury, Bridgeport, and New Haven while in this vicinity.

Bridgeport Branch held its annual meeting and banquet at the Stratfield Hotel on Saturday, May 1st. There was a good attendance and the weather was perfect. The speakers were Dr. Blum, Frank Mesle, Walter Meyer who had just returned from his trip to Europe, and George Hogaboom who very kindly consented to take the place of Oliver Sizelove. A feeling of sorrow was expressed by all present when it was learned that Mrs. Sizelove had passed to the great beyond on April 24. A message expressing regret was sent to Mr. Sizelove by the members present.

Walter Meyer gave a splendid talk, telling us all about his experiences in England and the Continent. It was so good that we won't tell it now; wait until you hear Walter give his talk and show his pictures at the Convention. You can't afford to miss it.

All the speakers were good. In fact they are all headliners and each one lived up to expectations. Generous applause greeted each one at the close of his address.

Somehow we wish our members would assemble on time. The time is so short that the speakers are rushed, and the Hotel Management gets anxious because the room is needed after a certain hour for other purposes. The fault lies in the members not in the committee. There is a lot of unnecessary lobbying which delays the meeting. All our branches are afflicted with the same disease even at the local meetings.

President Bridgett opened the meeting and turned it over to Ray O'Connor, who introduced the speakers.

One of the hardest working secretaries in our organization is Charlie Costello, the secretary of Bridgeport Branch. Charlie can always be depended on.

The banquet, floor show, orchestra and all were very good, and well appreciated.

New York, New Jersey and all the New England Branches were represented. F. J. MacStoker, General Chairman of the N. Y. Convention Committee as well as Past Supreme Presidents, George B. Hogaboom, Philip Seivering, John Sterling, and Horace South were present.

Watch Bob Leather's art gallery of past conventions at the Convention.

Remember the Convention dates, June 14-17.

BELKE ENLARGES RUBBER LINING DEPARTMENT TO ACCOMMODATE INCREASED DEMAND.

Due to the steadily increasing demand for rubber lined equipment during the past 5 years this division of the Belke Manufacturing Company has become so overcrowded that it has been necessary to acquire an additional building to house it.

The Belke Manufacturing Company has specialized in the rubber lining of plating tanks, blower equipment, mixing vats, storage tanks, industrial filters and tank cars for the past 17 years. Belke engineers have made a special study of the affects of different acids and plating solutions on rubber. Through the information gained by these tests they have developed individual

rubber formulas that will withstand any plating solution including chromic acid or boiling caustic and alkaline cleaner solutions. All the rubber used by the Belke Manufacturing Company is made by Goodyear according to Belke specifications, and is thoroughly tested by a high tension spark testing apparatus before and after it is applied to the base metal. This eliminates the slightest possibility of imperfect materials or workmanship.

The new plant has been equipped with the most modern facilities obtainable. It is manned by a staff of skilled workman who have received years of special training in this particular field.

A special feature of Belke Rubber Lining is the process by which it is applied. This is the famous Belke "Vacuum-Weld" Process. With this method the rubber coatings adhere so tenaciously to the base metal that mechanical separation is practically impossible.

In connection with this rubber lining department, the Belke Manufacturing Company also operates a patented Anodic Dip Process which now makes it possible to rubber cover many intricately shaped products which formerly required expensive original moulds.

This newly enlarged department with it scientific methods, special equipment and tremendous capacity effects substantial savings in the cost of rubber lined equipment.

ACID RESISTANT, UNBREAKABLE RUBBER PAIL

"Pour Control"— acid resistant — unbreakable, are some of the features claimed for a rubber pail recently introduced to the plating industry by the Udylite Company of Detroit.

The new pail is of seamless construction made of pure virgin latex carefully compounded to give high tensile strength (4000 lbs. per sq. inch). The pail is reinforced by sturdy ribs so that is will hold its full quota of liquid (12 quarts) without noticeable bulging. In addition the front side of the pail is reinforced with a 6″ double thick wall permitting easy undisturbed pouring when pail is resting on a narrow edge.

The Udylite Company claims this pail has a spout that really pours — said to be particularly advantageous in handling acids. The specially designed spout enables one to control accurately the size of the stream poured — from generous flow to fine trickle with no slopping over or spattering. There is the added feature of a detachable stainless steel handle which gives added rigidity around the entire top periphery of the pail.

The Udylite pail is flexible, resilient and can't be broken or dented. It can be hit, banged, stepped on, even run over without denting, cracking, or chipping. The manufacturer claims this feature alone adds months to the useful life of the pail and reduces replacement costs to a minimum. The Udylite Rubber Pail is 11″ dia., 10″ deep and weighs 6¼ lbs.

The Udylite Company, 1651 East Grand Boulevard, Detroit, Michigan

OFFICIAL PROGRAM

THE TWENTY-FIFTH ANNUAL CONVENTION — *THE SILVER JUBILEE OF THE A. E. S.*

NEW YORK CITY, JUNE 14th, 15th, 16th, AND 17th, 1937

HEADQUARTERS, PENNSYLVANIA HOTEL

SUNDAY AFTERNOON, JUNE 13th

2:00 p.m. Registration, Mezzanine Floor, Hotel Pennsylvania.
Registration fees: Men $9, Ladies $6, which entitles registrant to book of tickets to be used for all functions and activities.
Membership in Society is not necessary for registration.

MONDAY MORNING, JUNE 14th

8:30 a.m. Registration, Mezzanine Floor, Hotel Pennsylvania.
9:00 a.m. Welcoming of Delegates, Members and Visitors.
Franklyn J. MacStoker, General Chairman.
Ralph J. Liguori, President, New York Branch.
Welcome to New York.
Opening Session.
Charles H. Proctor, Founder of A. E. S.
Presidential Address.
E. Steen Thompson.
Business Session:
Presentation of credentials.
Submission of amendments to Constitution.

MONDAY AFTERNOON, JUNE 14th

Papers start promptly on time.
1:30 p.m. Educational Session — Hotel Pennsylvania Ballroom.

George B. Hogaboom, 1st president of the A. E. S., presiding.

1. Summary of Researches on Electrodeposition at the National Bureau of Standards:
   Dr. William Blum, U. S. Bureau of Standards.
2. Progress Report on Exposure Tests and Laboratory Tests of Plating on Non-Ferrous Metals:
   P. W. C. Strausser and *Dr. W. Blum.*
3. The Use of Color Photography in the Inspection of Exposure Tests of Plating:
   C. E. Vincent Davies and *Dr. W. Blum.*
4. A Magnetic Method for Measuring the Thickness of Nickel Coatings on Non-Ferrous Metals:
   A. Brenner, U. S. Bureau of Standards.
5. Experiences in Evaluating Plated Coatings:
   W. S. Pinner and *L. B. Sperry*, Detroit Branch.

MONDAY EVENING, JUNE 14th

8:30 p.m. International Fellowship Club — Open House.
Ball Room, Hotel Pennsylvania.
This night will be devoted to a party for men and ladies sponsored by
The International Fellowship Club.
We look forward to the pleasure of entertaining you. We welcome you as our guest. A ticket is included in the Book of Tickets which must be used for admittance to this affair.
A Night of Entertainment
Dancing Refreshments
For complete details see I. F. C. Folder enclosed with program.

TUESDAY MORNING, JUNE 15th

9:15 a.m. A tour of New York City in de luxe coaches of the Gray Line Motor Tours, Inc. A delightful trip through the Metropolis to points of known interest. Coaches leave promptly on time from Hotel Pennsylvania.

TUESDAY AFTERNOON, JUNE 15th

2:00 p.m. An inspection tour of the modern S. S. Normandie, at anchor in New York Harbor. An opportunity to inspect one of the great ocean liners.

TUESDAY, EVENING, JUNE 15th

Papers start promptly on time.

7:30 p.m. Educational Session:

1. A Discussion on Barrel Electroplating:
   Presented by Philadelphia Branch.
2. Electroplating in Europe and the First International Electrodeposition Conference:
   Walter R. Meyer, Electrochemist, General Electric Co., Bridgeport, Conn.
3. The Effect of Free Cyanide on the Cathode Efficiency of Silver Plating Solutions:
   Messrs. Hirsch, Jackson, Snyder, and *Venelle*, of Philadelphia Branch.
4. The Prevention of Spotting Out:
   A review of conditions affecting the occurence of Crystal and stain spotting and methods for their prevention.
   Gustave Klinkenstein, vice-president and technical director, Maas & Waldstein Company.

WEDNESDAY MORNING, JUNE 16th

Papers start promptly on time.

9:00 a.m. Educational Session:
John E. Sterling, New York Branch, past president of the A. E. S., presiding.
presiding.

1. Health Hazards in the Plating Room:
   Presented by Cleveland Branch.
2. The Cathode Efficiency of Electroplating Barrels and Its Effect on the Adhesion of Nickel Deposits:
   Albert Hirsch, Electroplater and Chemist, Carey McFall Company, Philadelphia, Pa.

3. A Resumé of Silver Plating:
   F. C. Mesle, electrochemist, Oneida, Ltd., Oneida, N. Y.
4. Simple Ideas that Worked:
   W. S. Barrows, foreman electroplater, Toronto Branch.
5. *Mr. Leo Roon*, Roxalin Flexible Lacquer Company.
   Title of paper not yet known.

WEDNESDAY AFTERNOON, JUNE 16th

2:00 p.m. A guided tour of Radio City and NBC Studios, starting from the NBC Studios promptly at 2:00 p.m. This tour will take approximately three hours.

WEDNESDAY EVENING, JUNE 16th

Papers start promptly on time.

7:30 p.m. Educational Session:

7:30 p.m.: Horace Smith, Newark Branch, past president of the A.E.S., presiding.

1. Gold Electroplating:
   Presented by Newark Branch.
2. The Barrel Rolling of Metal Parts:
   Presented by Waterbury Branch.
3. Something New in Silver Plating:
   Donald Wood, Reed & Barton Company, Taunton, Mass.
4. Air Conditioning of the Plating Plant:
   Edward C. DeLorme of Boston Branch.

THURSDAY MORNING, JUNE 17th

Papers start promptly on time.

9:00 a.m. Educational Session:

Oscar E. Servis, Chicago Branch, past president of A.E.S., presiding.

1. Brass Plating:
   As practiced by Members of the Bridgeport Branch.
2. 101 Questions on Cyanide Copper Plating:
   Contributed by members of Rochester Branch, to be read by *Frank J. Kohlmeier*, foreman electroplater Bausch & Lomb Optical Company, Rochester, N. Y.
3. The pH of Alkaline Plating Solutions:
   George B. Hogaboom, Hanson-Van Winkle-Munning Company.
4. The Manufacture of Rhodium Plating Solutions:
   Lionel Cinamon, Ch. E., Special Chemicals Corp., New York City, Member of New York Branch.

THURSDAY AFTERNOON, JUNE 17th

1:30 p.m. Final Business Session:
Discussion of Amendments.
Election of Officers.
Selection of Convention City.

THURSDAY EVENING, JUNE 17th

7:30 p.m. Banquet and Dance:
Hotel Pennsylvania Ball Room.
Informal
Entertainment — N. T. G. Master of Ceremonies and his Hollywood Revue.

THE PLATED WARE EXHIBIT

Attention is particularly directed to the exhibit of plated ware, submitted by Branches and individual foremen platers. This will be one of the outstanding features of the Convention, and worth anyone's interest and attention.

THREE GRAND PRIZES will be awarded the best exhibits shown.

PROGRAM FOR THE LADIES

Sunday, June 13th

2:30 p.m. Registration and Reception.

Monday, June 14th

Place — Hotel Pennsylvania
Time — 4:00 to 5:00 p.m.
Event— "GET ACQUAINTED HOUR"

Evening Accompanying the men as guests of The International Fellowship Club.

Tuesday, June 15th

Morning Accompanying the men on a tour of the Greater City to points of known interest.

Afternoon Accompanying the men on an inspection tour of the modern ocean liner Normandie.

Evening Place — Paradise Cabaret Restaurant
Time — 6:00 p.m.
Events—DINNER DANCE REVUE

Wednesday, June 16th

Morning See a Radio Broadcast.

Afternoon Accompanying the men on a tour through Radio City.

Evening (By courtesy of the International Fellowship Club)
Place — A New York Theatre.
Time — 8:30 p.m.
Event— A Current Outstanding New York Show.

Thursday, June 17th

Morning Open.

Afternoon Place — Hotel Pennsylvania.
Time — 1:00 to 5:00 p.m.
Event— A Party, with 20 Magnificent Grand Prizes, by courtesy of the International Fellowship Club.
Bridge and Card Party — Fortune Telling by the Narraganset Indian Princess Reba.
Refreshments — Prizes.

Evening Accompanying the men to the BANQUET.

Business and Social News

BRANCH NEWS

Educational Activities

AMERICAN ELECTRO-PLATERS' SOCIETY

WATERBURY BRANCH

The regular monthly meeting of Waterbury Branch A. E. S. was held Friday evening, April 9th, in Engineers Hall. The meeting which was presided over by President Tennant Elwin, was well attended. As there was no speaker scheduled for the evening, it was decided to devote most of the time to the paper to be presented by the local branch at the coming convention in New York City. Librarian Ellsworth Candee had the paper in charge, and was the recipient of many ideas and suggestions in the compilation of same.

Joseph Muscio gave an interesting talk on the mechanics of ball burnishing mesh bag frames.

Favorable action having been taken on the application of William P. North for associate membership he was declared elected. Application for active membership was received from James Russell Wetmore, American Brass Co. Ordered to take the usual course.

Henry Mahlstedt chairman of the local membership committee presented a list of nearly fifty prospects to whom circulars explaining the object and purposes of the A.E.S. had been sent. A follow-up program was discussed and work on same was expected to start at once. The meeting was favored with the presence of executive secretary, Wm. J. R. Kennedy who is always a welcome visitor at the local branch. "Bill" did not come empty-handed for besides his brief case, he brought along a prospective candidate from the nearby town of Cheshire.

Secretary Kennedy gave an interesting talk on the progress of the A.E.S. and the coming national convention to be held in New York City in June.

Circulars describing the work of the research department at the National Bureau of Standards and the Silver Jubilee of the American Electro-Platers' Society, was distributed at the meeting. At the close of the meeting refreshments were served.

The next meeting of the Branch will take place Friday evening, May 14th, at which time the annual election of officers and delegates will take place.

W. F. GUILFOILE, *Sec.*

CLEVELAND BRANCH

The regular monthly meeting of the Cleveland Branch of the American Electro-Platers' Society was held at Hotel Cleveland on April 3, 1937.

The meeting was called to order by our president, Mr. W. D. Scott at 8:15 p. m.

An application for an associate membership was made by Mr. Robert Renton, which brought out quite a discussion on eligibility. Due to the by-laws of our organization he was not turned over to our board of managers for investigation.

Mr. Lyons reported about the cards that were signed up at the convention, and those in this territory were turned over to him by our new membership vice president, Mr. Eichstaedt to contact for membership. After reading off the names and their occupations it was found that there would be about four that would be eligible.

Mr. O'Conner made a motion that the three delegates for the convention be allowed $75.00 for each delegate as

expense money and to be taken out of the funds of the society. This motion was seconded by Mr. Stroh, voted on and carried.

The meeting was then turned over to our Librarian who gave a skeleton outline of the paper to be presented at the convention.

On a motion made by Mr. Singler and seconded by Mr. Ott that we have some refreshments, carried.

Meeting adjourned.

WM. E. O'BERG, *Sec.-Treas.*

MILWAUKEE BRANCH

Milwaukee Branch held its regular meeting with President Rhodes presiding; all officers present, and thirty-five active members made it a good meeting. Let us not hope it was the lunch and refreshments that attracted most of the good men. Minutes of last meeting were read and approved in good fashion.

Our membership drive is progressing very well, with four new men turning in applications; Walter R. Draeger and Chas. L. Cope as active members and Herbert F. Thieman and Russel C. Rothe as associate members.

Mr. P. J. Ritzenthaler of the Cutler-Hammer Company gave us an interesting talk on the comparative costs of cadmium and zinc. To the uninitiated it would appear on the surface as if there would be a tremendous difference in costs between the two metals, however, when the additional cleaning and pickling is added to the zinc cost, which is apparently necessary to get a strongly adherent coating, there is the following variation in price. Cadmium with a minimum coating of .0003" equals a cost of .0227 per square foot, while zinc with a minimum coating of .0005" equals a cost of .0192 per square foot. The additional thickness being necessary in zinc to get a comparative protection.

Milwaukee members are still looking for a method of rinsing bright nickel deposits which will not show a smear or a streak after drying. Who of all our members has thoroughly licked this job?

We have been promised an interesting paper on lacquers and operenda for our next meeting.

A. J. HERMANSEN, *Sec.-Treas.*

BINGHAMTON-ELMIRA BRANCH

The Binghamton-Elmira Branch of the A.E.S. held their monthly dinner meeting at the Y.M.C.A., Binghamton, N. Y., Monday, April 6th at 6.30 P.M.

We were honored by the presence of Mr. George Hogaboom, who gave a very interesting talk on "What Does the Ammeter Tell?" Lantern slides were used to demonstrate the results of his experiments. Photographs depicting the structure of the different electro-deposits resulting from different chemical combinations in the plating solutions aided materially. Mr. Hogaboom's argument that we must standardize on our plating solutions if we hope to get the same results in a certain length of plating time at a certain current density. His charts and photographs bore out his argument very well. We must all agree with Mr. Hogaboom, but it is going to be a difficult proposition to convince most platers that there is a better nickel solution than the one he is using. Something must be done along this line and we know of none better suited than Mr. Hogaboom to start the ball rolling.

The meeting closed with a vote of thanks to Mr. Hogaboom.

LARRY MEYER, *Sec.*

CHICAGO BRANCH

The regular monthly meeting of Chicago Branch was held April 10,1937 at the Atlantic Hotel.

President G. Jelinek presided and all other officers were present.

The new applications of J. E. Carlson, W. H. Smith and P. P. Szymanski were read and committees appointed on same.

Mr. J. J. Loop was elected an active member, and Mr. V. Mattacotti was elected an associate member of Chicago Branch.

A letter from Milwaukee branch regarding their Annual Educational meeting and smoker read and placed on file.

An outline of the coming events at our 25th Annual convention to be held in New York in June received from Mr. F. J. MacStoker, the General Chairman, read and placed on file.

A progress report on the Supplementary test on Non-Ferrous Metals by Dr. W. Blum read and placed on file.

Mr. J. Pearsall of the Udylite Co. made a very interesting talk on Polishing and Buffing costs and urged all foremen to get busy and spend some time on this very important subject.

The librarian Mr. O. E. Servis found the following questions in the question box.

1. *What is a good method of getting a good adherent deposit of brass on stainless steel? There is no objection to having nickel or any other deposit under it.*

Answer. A 5% Hydrochloric & Nitric acid etch with reverse current. Another member stated that he has very good results in barrel plating by etching the steel in Agua, Regia.

2. *Is there any paint that will withstand the acid fumes in the plating Department?*

Answer. An ashfaltum base with aluminum paint made by the Hooker Paint Co. gives very good results.

3. *Is air agitation in a die cast nickel solution as good as mechanical agitation?*

Answer. Mechanical agitation gives the best results.

J. W. HANLON, *Sec.*

LOS ANGELES BRANCH

Minutes of the Los Angeles Branch A.E.S. regular monthly meeting held March 10, 1937 at the Rosslyn Hotel.

Roll call showed sixteen members and two visitors present. President E. R. Williams presided.

Letters were read from the Chicago Branch, New York Branch, Lea Mfg. Co. and Mr. Barrows of the Toronto Branch. A committee consisting of Lamoureux, Thornton and Rynkofs was appointed to act on the amendments suggested by the Chicago Branch.

The secretary was instructed to write the New York Branch stating that this branch was not in a position to submit a paper for the National Convention. The letter from the Lea Mfg. Co. was turned over to Mr. Lamoureux. The questions asked by Mr. Barrows were taken up by the librarian and the secretary was instructed to forward the answers to Mr. Barrows.

Mr. Lamoureux reported that plans for the educational meeting and dinner dance to be held March 20th were progressing favorably.

Mr. Solivan was instructed to contract for the music for the evening.

There was only one question in the question box: Want some information on lead plating steel parts. Heavy deposit. No one present was able to give much information. It was suggested that the person asking the question write Dr. Blum at the Bureau of Standards, Washington, D. C.

EARL COFFIN, *Sec.-Treas.*

NEWARK BRANCH

The regular meeting of the Newark Branch, A.E.S., was held on Friday evening, April 2, 1937, at the Krueger Club, Belmont and Springfield Aves., Newark, N. J.

The meeting was called to order at 8:30 P.M. by President Samuel Taylor.

The minutes of the previous meeting were read and approved.

An application for Mr. Charles R. Campana was voted on to take the regular course.

A request from David X. Clarin for a transfer to New York Branch was granted.

A letter from the Platers and Platers Helpers Union Local No. 26 was read and the Secretary was instructed to answer same.

Plans for the Annual Banquet and Educational Session was the main topic of the evening.

As our Librarian, Mr. Paul Oldam, was unable to remain with us the questions on Gold Plating were held over for the next meeting.

Meeting adjourned at 10:30 P.M.

Newark will provide a brass band for the first evening's entertainment at the Convention.

The regular meeting of the Newark Branch, A.E.S., was held on Friday evening, April 16, 1937, at the Kreuger Club, Belmont and Springfield Aves., Newark, N. J. The meeting was called to order by President Samuel Taylor at 8:30 P.M. The minutes of the previous meeting were read and approved.

An application for Mr. Raymond Thomas was voted on to take the regular course.

Mr. Horace Smith, Chairman of the Banquet Committee, reported that both the Afternoon Session and the Evening Banquet were a huge success and it was voted that the Secretary send a letter of thanks to the entertainers who had given a wonderful performance without cost to the Branch.

On motion duly made and seconded it was voted that Newark Branch would hire a Brass Band of 40 pieces, which the committee had reviewed, for the first evening of the New York Convention.

Mr. Oldam, our Librarian, received some more data on Gold Plating and he informed us that the paper would be completed within a short time.

Meeting adjourned at 11:00 P.M.

GEORGE WAGNER, *Sec.*

TORONTO BRANCH

Over fifty per cent of our local membership were present at the April meeting of Toronto Branch. Officers for the coming year were nominated. Letters from Boston, Milwaukee, and New York were given attention and laid over for our May meeting.

The committee in charge of the card party held April 16th, reported the affair as a great success. Eighty people were present, thirty-two prizes were awarded and the luncheon was of unusual quality and quantity. These card parties are becoming more and more popular each year. The feature of our April meeting was a demonstration of the copper oxide metal rectifier, by Messrs, Acheson and Smith. This being the first time our members have had an opportunity to see this type of electrical device, we were all greatly interested. Mr. Smith showed charts and diagrams which made the demonstration very easily understood.

On May 8th a large contingent of platers from this locality will visit the

Port Colborne nickel refinery. More about the trip in our next report.

President Acheson assured the members that a trip to New York to attend the Convention would make a splendid vacation for any plater.

Messrs. T. O'Keefe, C. Kemish and H. W. Graham were complimented for their splendid work in connection with the card party.

Harry Hand is once more with us, apparently fully recovered from the effects of a very trying illness.

W. F. BARROWS, *Sec.*

PHILADELPHIA BRANCH

Philadelphia Branch held its regular meeting Friday, April 13, 1937, 8:00 P.M. Meeting called to order by President Al. Hirsch. Roll of officers all present but Mr. P. Uhl. Minutes of previous meeting read and approved. Communication from Bridgeport Branch read. Moved and seconded that same be placed on file and members try to attend educational session and banquet. Communication from Milwaukee Branch read, moved and seconded that same be placed on file. The following officers were nominated: Pres., Joe E. Underwood; Vice-Pres., Fred Fulforth; Sec.-Treas., R. E. Jackson, Jr.; Librarian, E. J. Zurback, Jr.; Board of Managers, H. Snyder, H. Keller, G. Gehling, Warren A. Reynolds; Delegates to Convention, Joe E. Underwood, Al. Hirsch, G. Long, R. E. Jackson, Jr.; Alternates, H. Keller, H. C. Shelly, E. J. Zurback, Jr. Communication from Chicago Branch read, moved and seconded that the delegates be instructed to vote no to proposed amendment known as Art. IX, Part 2, Sec. 1. Carried. Communication from Chicago Branch read, moved and seconded that delegates to use their own discretion with regard to proposed amendment known as Art. III, Part 1, Sec. 1 and 2. Carried. Moved and seconded that a committee be appointed to meet and entertain Dr. S. Wernick, Hon. Sec. of the Electrodepositors' Technical Society during his visit in this country. The following committee was appointed: Dr. E. B. Sanigar, Mr. W. A. Reynolds, Mr. G. Gehling, Mr. Al. Hirsch. Moved and seconded that Philadelphia Branch hold an Upstate Meeting in September and a Committee be appointed for the same. Carried. The Committee: Mr. J. L. Nelson, J. E. Underwood, Mr. G. Gehling, Mr. A. M. Robson, Mr. Fred Fulforth, Mr. J. L. Nelson. The Librarian will give a demonstration of a microscopic test for thickness at our next meeting. The pieces will be

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furnished by Mr. F. Fulforth and Mr. Nelson will prepare and exhibit them. DON'T miss this. Also we should have a large attendance as this is the meeting you select your officers and delegates. Don't forget the date, May 21, 1937, 8:00 P.M. There being no further business meeting, adjourned.

ROBERT E. JACKSON, JR., *Sec.*

ANDERSON BRANCH

Anderson Branch gathered for a dinner meeting April 26, 1937, at the Y. M. C. A. There were twenty-six members present. After the food was satisfactorily taken care of, President Minton complimented the branch on their good turnout. It is unfortunate that many members cannot attend meetings owing to their night shift work, but they are loyal members none the less.

The President introduced our old friend George Hogaboom as the speaker. Mr. Hogaboom's subject "What the Ammeter Tells" held the interest of everyone throughout the lecture. He pointed out that the ammeter told nothing whatever except the amount of current passing from the generator to the plating tank. So many factors such as solution analysis, temperature, pH value, anode area, anode polarization, current density, etc., have such a bearing on the character of the electrodeposit that no one can, merely by looking at the ammeter, foretell any of the characteristics of the plate. By means of photomicrographic slides, he showed the fallacy of thickness specifications. Some of the slides showed a thickness greater than others but owing to the coarse and irregular crystalline structure and polarization lines, they were of less protective value than the thinner, but more dense and uniform deposit.

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64-68—1⅛" arbor—20 ply

Full Disc - Loose - or Sewed

Thousands of every size

8"—8¢ each 9"—9¢ each

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He concluded his talk with a strong plea for more standard solutions and more accurate control and knowledge of plating conditions. Questions followed thick and fast but Mr. Hogaboom answered them all to everyone's satisfaction.

We then had a ten minute recess to allow the guests to withdraw after which we had a brief business meeting.

The application of Dr. Merton Beckwith was presented and unanimously elected to membership. We are glad to have Dr. Beckwith and believe he will be an asset to the Society.

The subject of the banquet was discussed and we decided to hold it Saturday, May 22. The following committees were appointed:

Program: Robert Wagner, Guy Cole, Guy Cheney.

Tickets: William Castell, Merton Beckwith, George Lowther.

Dinner and Hotel Arrangements: Lucien Hinsch, Roy Phillips, Otto McCallister.

Liquid Refreshments: Roy Shockley, Guy Cheney.

Publicity: D. A. Cotton, George Berg, Edgar McKinney.

The enthusiasm aroused predicted a highly successful banquet and the committees will swing promptly into action. Meeting adjourned at 10:00 P.M. L. R. HINSCH, *Sec.*

ROCHESTER BRANCH

The March meeting of the Rochester Branch was held on March 19. Meeting called to order by Pres. Kohlmeier. Sec. Elster being absent the chair appointed Mr. Lux as Sec. Pro Tem. Regular business was transacted during which Mr. Elmer Nill was elected as an active member. After the business meeting the discussion turned to a discussion of the paper to be presented at the Convention. Mr. Lux reading a suggested outline for the members' comments. There was much discussion after which the meeting was adjourned.

The April meeting was held on April 23. Meeting called to order by Pres. Kohlmeier. Sec. Elster again being absent the chair again turned to Mr. Lux for assistance. Minutes of previous meeting read and approved. Two letters from the Milwaukee Branch were read and ordered held over to next meeting for action. Letter from Boston Branch on changes to constitution was considered. Letter from Chicago Branch was also considered. The applications of Mr. R. E. Pettit and Mr. A. H. Doering for reinstatement were acted upon and accepted. The application of Mr. Alfred McGuire was ordered published. Mr. Philip LoPresti asked to be transferred from the Waterbury Branch. Secretary was ordered to take care of the transfer. After a little further business the meeting was adjourned.

JUDSON R. ELSTER, *Sec.*

PROVIDENCE-ATTLEBORO BRANCH

The Providence-Attleboro Branch held its regular meeting, Friday April 23, 1937, at the Narragansett Hotel.

Mr. Joseph Smith was the speaker and he talked on "Silver Plating." He described several methods of making a silver bath e.g.:

No. 1.

The Electrolytic Solution:

Using a solution of Potassium Cyanide as the electrolyte and, placing there-in a porous cell containing some of the same solution, an anode of silver

NEW Magnus Method Cuts "Rejects."

A large manufacturer was experiencing as high as 10% rejects, removing grease, oil and drawing compound from steel parts before finishing.

The parts are now cleaned with MAGNUS #78, then simply rinsed, dried and sprayed. A thorough examination after baking fails to locate bubbles, poor adhesion or white haze.

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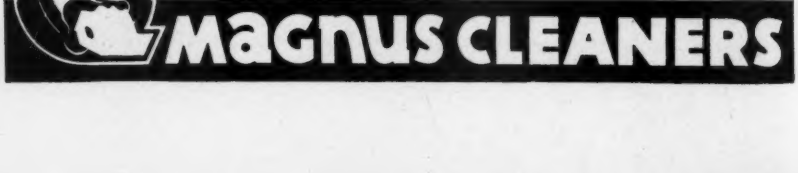

is placed, in circuit, in the main solution, and a cathode of iron or copper is placed, in circuit, in the porous cell, and this set-up is to be electrolyzed until the desired amount of silver has been dissolved; the continuous electrolyzing tends to convert some of the cyanide to hydroxide and this, in turn, is gradually changed to carbonate.

No. 2.

The Chemical Bath:

This is to be made by dissolving pure grain silver in a mixture of equal parts of nitric acid and water, in a Florence-Flask, the flask to be placed in a hot water bath; to the silver nitrate, thus formed, is to be added a solution of sodium-carbonate, as long as a precipitate is formed (this precipitate is very light so one must be careful in washing), then enough of a solution of potassium is to be added to just dissolve the precipitate.

No. 3.

Chemical Bath B.:

To a solution of silver nitrate, as above, add, with stirring, a solution of potassium cyanide, as long as a precipitate is formed, using extreme care to avoid an excess of the cyanide; this precipitate should be washed several times with hot water, then cyanide solution is to be added until the precipitate is just dissolved.

By way of explaining the management of these solutions, Mr. Smith stated that:

2 ozs. of metal per gal. is better economically, than 4 ozs.;

A more dilute solution is a better conductor, within limits, than a dense solution;

All dissociated ions take part in the action, but all are not deposited;

The presence of a large free cyanide is necessary in order to dissolve the silver cyanide as quickly as formed.

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The current tension should not exceed 1-112 volts, unless the work is moved;

The movement of the cathode is of great importance;

The amount of free cyanide should be equal to that required to precipitate the silver (as in the silver cyanide precipitate).

There was an interesting question period after the talk.

Joe Smith has as a background, a lifetime of practical experience in electroplating; he has originated several methods of plating. He represents the Baker Co., of Newark, N. J. He also teaches the class in Electroplating, at the School of Design.

J. ANDREWS, *Sec.*

SPRINGFIELD BRANCH

The regular monthly meeting of the Springfield Branch A. E. S. was held Monday evening, April 26, 1937, with Vice-President Barrus in the chair.

The minutes of the previous meeting were read and approved.

All communications were read and placed on file.

The bill for the per capita tax was voted to be paid.

A motion was made and carried that the chair appoint a nominating committee to bring in a slate of officers to be voted upon at the regular May meeting. Mr. Frank Clark, Mr. T. J. Murray, and Mr. W. J. R. Kennedy were appointed.

The applications of five prospective members were read and took the usual course.

The speaker of the evening was Mr. Gibson, of the Houghton Company Philadelphia.

The subject was, "Drawing compounds as related to the finishing of metals." He brought out many interesting facts to prove that the manufacturers of drawing compounds were doing much research work in cooperation with platers and finishers, to overcome difficulties that previously were blamed on improper cleaning.

At the conclusion, he answered many questions asked by various members, after which he was given a rising vote of thanks.

The meeting adjourned at 10:50 p.m.

HENRY DELARM, *Sec.*

HARTFORD BRANCH

The Hartford Branch of the A. E. S. held its regular monthly meeting on Monday evening, April 19, 1937, at the Hartford State Trade School, Hartford, Conn.

The meeting was called to order at 8:30 P.M. with Pres. Peterson in the Chair. Minutes of the previous meeting were read and accepted. All communications were read and placed on file. No bills were presented.

Under new business, three applications were voted to take the usual course. Two for associate and one for active membership.

A Nominating Committee was appointed to secure names for office election which is to be held next month. The Committee consists of Mr. Jos. Pietro, Mr. Alex Christie, and Mr. Emil Garanson.

The secretary was instructed to have a letter made out and sent to different manufacturers to stimulate interest in regard to the A. E. S. and its work.

The secretary read the Boston Branch's proposed amendment which caused much discussion, as did the proposed amendments of the Chicago Branch. These were tabled for the next meeting.

The Hartford Branch was fortunate in having as speaker for the evening, our own "Bill Kennedy" who gave an interesting talk on the growth of the REVIEW and how plans are being made for still further growth.

We also had as a speaker Mr. Conradi of the International Business Machine Co., of Binghamton, N. Y., who gave a short but very interesting talk to us.

Both talks were thoroughly enjoyed. In conclusion both speakers were given a rising vote of thanks.

VERNON E. GRANT, *Sec.*

ANNOUNCEMENT

The Special Chemicals Corp. wish to announce that they have been granted patent No. 2079842 on the manufacture and use of their SPEKWITE plating compounds. They are now in a position to offer patent protection on this tarnish resisting white plate to all their customers.

CLEVELAND BRANCH

The regular monthly meeting of the Cleveland Branch of the American Electro-Platers' Society, was held at Hotel Carter Saturday, May 1st, 1937. The meeting was called to order by our president Mr. William D. Scott at 8:15 p.m.

An application for active membership was made by Mr. Edward Joseph Essner, of the Apex Electrical Co. The application of Mr. Richard M. Smith of the Cleveland Graphite Bronze Co. was passed by our Board of Managers, the result being his election.

A transfer from the Boston Branch was received from Mr. John Yingling of 1651 East 93rd Street, Cleveland, Ohio. We are extremely glad to add Mr. Yingling as a member to our Cleveland Branch.

The letters regarding the changes in the constitution were read and ordered to be reread at the next meeting at which time the delegates will be instructed as to how to vote.

Our librarian then gave a brief outline of our paper to be read at the coming convention.

The meeting was then turned over for the election of officers for the 1937-1938 terms, with the following results:

President, Mr. William D. Scott; *Vice-President*, Mr. Fred Matts; *Secretary-Treasurer*, Mr. Charles F. Ott; *Librarian*, Mr. Fred M. Carlson; *Board of Managers*, Mr. Joseph C. Singler, P. R. Lyons, Mr. Thomas F. O'Connor; *Delegates to Convention*, Mr. Eric Steen Thompson, Mr. William D. Scott, Mr. Joseph C. Singler; *Alternates*, Mr. William O'Berg, Mr. Charles F. Ott, Mr. Gregory Stroh.

After this election of officers refreshments were served and the meeting adjourned.

WILLIAM O'BERG, *Sec.-Treas.*

BALTIMORE WASHINGTON BRANCH

At our meeting on Saturday, May 1, the Baltimore-Washington Branch held its annual election of officers and delegates. We elected two new members to the Branch.

We announce the death of Mr. Mathias F. Lassance, who passed away Friday evening, April 30.

IRVIN H. HAHN, *Sec.*

DETROIT BRANCH

Minutes of the meeting of May 7th, Detroit Branch of American Electro-Platers' Society.

The meeting was held at Hotel Statler. Our president, Mr. A. B. Wilson, was not able to attend this meeting as he is in the hospital recovering from an emergency operation for appendicitis. Our vice-president, Mr. George Kutzen, was also absent, therefore, our chairman of the Board of Managers, Mr. William W. McCord, acted as chairman of the meeting.

Minutes of the previous meeting were read and approved.

A letter from the chairman of the Exhibit Committee of the Convention was read relative to Detroit Branch getting busy on a representative exhibit. This was discussed and a committee was appointed to solicit exhibits. The committee, consisting of Mr. B. F. Lewis, Mr. Mose Cherry, and Lester Southwick.

Then followed the nominations of officers for the next fiscal year. Mr.

A. B. Wilson was nominated for President, Mr. Raymond Simsick for Vice-president; Mr. T. C. Eichstaedt, Secretary-Treasurer; Mr, B. F. Lewis. Librarian.

Nominations for Board of Managers: Walter Pinner, James Higgins, Charles Eldridge, Charles Marker, Charles Beaubien, and George Kutzen.

Nominations for delegates to the Convention: T. C. Eichstaedt, A. B. Wilson, Gordon Spencer, Raymond Simsick, Walter Pinner, James Higgins, George Kutzen, and Henry Frank.

The amendments proposed by the Chicago Branch were read and laid over for action until next meeting as were also the amendments proposed by the Boston Branch. The speaker of the evening was then introduced, Professor Baker of the University of Michigan and his topic was "Causes of Pitting in Nickel Deposits." His talk was illustrated with slides and they were very interesting as well as educating. After he got through with his talk there was quite a discussion and many questions were asked and answered. Mr. Baker was given a rousing vote of thanks and applause for his talk of the evening.

We had present a guest, Dr. S. Wernech, Honorary Secretary of the Electro-Depositors Technical Society, North Hampton Poly-Technic Institute, St. Johns St., London, E.C.1. Dr. Werneck was introduced and sprung a very pleasant surprise. It seems that he had come prepared to give us a talk which he did. He also had an abundant supply of slides of illustrations of plating plants and equipment in England. He is making a tour of the United States plating centers and visiting the larger plants. He gave us quite an illustration of transformers of which they are using quite a few in England to take the place of our motor generator sets. Altogether, Mr. Werneck was very well received and his talk was very much liked and he was given a rising vote of thanks but he in turn thanked our Society for the opportunity given him of this talk and he expressed great pleasure in having been present at the Detroit Branch Meeting and stated that he had been looking forward to it.

As the hour was getting late the Question Box was omitted for the evening.

Meeting adjourned at 10:40 p.m.

T. C. EICHSTAEDT, *Sec.-Treas.*

CHICAGO BRANCH

The regular monthly meeting of Chicago Branch was held May 8, 1937 at the Atlantic Hotel.

Vice-president M. H. Longfield presided and all other officers were present.

Mr. J. E. Carlson was elected an active member, Mr. P. P. Szymanski and Mr. W. H. Smith were elected to associate membership.

A letter was read from Mr. R. J. Liguori, Chairman of the General Program Committee and referred to a committee to see if any branch exhibits can be presented. All members were urged to try to get up any individual exhibit they could and to get in touch with the committee.

The proposed amendment to the constitution sponsored by Boston Branch was read and the delegates instructed to vote against this amendment.

There will be a Smoker and Booster meeting held June 5 with refreshments and all members are urged to be present.

The following officers were elected for the fiscal year starting June 1st: Mr. E. Stepka, President; Mr. M. H. Longfield, Vice-president; J. W. Han-

lon, Secretary-Treasurer; Mr. O. E. Servis, Librarian; Mr. O. Weickman, Mr. J. Bryden, Mr. E. Lanz, Board of Managers.

The following delegates were elected for the coming convention at New York: F. J. Hanlon, O. E. Servis, J. W. Hanlon; Alternates, H. A. Gilbertson, M. H. Longfield, Geo. Westerburg.

The librarian found the following questions in the question box.

No. 1. Does a cleaning conveyor with solvent degreasing clean the work good enough for enameling and mechanical plating?

Ans. Yes, it does for enameling but the work to be plated should be run through an alkali cleaning solution after degreasing.

No. 2. What is a good nickel solution for plating zinc base die castings? Is it advisable to use an acid dip before plating and what acid?

Ans. 10 oz. Nickel Salts, 8 oz. Sodium Sulphate, 3 oz. Salt, 3 oz. Boric Acid. pH.5.9 to 6.4. Use an acid dip of 1% Hydrofluoric Acid. One member stated that he has very good results from a solution of 7½ oz. single nickel salts and 3½ oz. Ammonium Chloride, but due to this solution not having any boric acid the pH. must be watched very closely if it is worked hard.

J. W. HANLON, *Sec.*

Mrs. Oliver J. Sizelove

Those who attended the Bridgeport meeting on Saturday, May 1st, were shocked to learn that Mrs. Sizelove had passed away on April 24.

Being in poor health for sometime, it was hoped she would eventually recover. A relapse occurred however, and the end came rather unexpectedly.

This breaking of the family circle through the death of Mrs. Sizelove is a cause for deep regret. The officers of the Supreme Society and every member of the A. E. S. express to Mr. Sizelove and his family our sincerest sympathy in their time of sorrow and bereavement.

George H. Cartlidge

One of Connecticut's Oldest and Most Respected Platers Passes Away

George H. Cartlidge, 81, of 72 Washington Circle died at Hartford Hospital March 21, 1937. Mr. Cartlidge was born in England May 12, 1855, and worked for the P. F. Corbin Company, New Britain, for twenty years, starting as a messenger boy. An opportunity to learn the plating trade was given to young Cartlidge which he accepted and rose step by step until he became plating superintendent.

After severing his connection with the Corbin Co., Mr. Cartlidge was employed by the Hart Mfg. Co. of Hartford in 1905. Here he had charge of the plating departments for more than thirty years.

Being devotedly attached to Mr. Gerald W. Hart, he was noticeably affected by his employer's death in March 1931.

Mr. Cartlidge's first wife died July 4, 1915. He is survived by his second wife, Josephine Kernan Cartlidge. We take this opportunity of extending to Mrs. Cartlidge our sincerest sympathy in the loss sustained by the death of her husband.

The Abstract Section

JAMES W. HANLON, *Chairman, Program and Educational Committee*

Removal of Grease before Electroplating, A DARLAY. *Galvano* Nov. 1936, p. 19, and Dec. 1936, p. 13—The author expresses a strong preference for the use of an alkaline electrolytic cleaner containing a copper salt, so that a coating of copper accompanies the cleaning process. He states that it is much more reliable than the usual cleaner consisting of alkali and cyanide alone. The use and control of this coppering cleaner is discussed. No mention is made of the vapor degreaser. C. T. THOMAS.

The Use of Rectifiers in Plating Shops, A. JULET. *Galvano* (Paris), Feb. 1937, p. 20. In the use of the rectifier for plating purposes, the principal regulation is made by changes in the take-off from the transformer. Further regulation is obtained from rheostats in the plating circuit. Where very close control is necessary, an inductive regulator may be installed. Efficiency curves show values of 70% to 76% over a range of about one-quarter to full capacity. The power factor is particularly good, rising to 0.9 at 40% of full load. Large overcharges for a short time do no damage. The elements are protected against overheating by fuses or magneto-thermic relays.

The installation is most simple and convenient. A supply of clean fresh air for ventilation is the only necessary precaution. The only care required consists of oiling the small ventilating fan once a month and blowing out the dust at regular intervals.

In many cases, the use of a single motor-generator set to supply a variety of tank voltages is much less efficient than a combination of rectifiers adapted to each requirement would be.

In summing up, the following advantages are claimed: practically unlimited life, no maintenance, operation without constant inspection, no radio interference, absolutely safe. Also, the efficiency and the power factor are high, there is no care and expense comparable to that of maintaining brushes and commutators on motor generator sets, the installation is most simple, and the operation is quite simple and easy.

Note: This concludes the discussion begun in the previous issue of *Jalvano.* The editor's preface notes that these are pros and cons on the subject, this article being decidedly of the former class. C. T. THOMAS.

Abstracts of papers read at First International Electro-deposition Conference, London, England, March 3 and 4, 1937. (These papers were issued as preprints, and will be published in bound form in the Proceedings of the Electrodepositors' Technical Society.)

Studies in evaluating the brightness of electrodeposits, B. EGEBERG and N. E. PROMISEL—Efforts were made, principally with silver, to so measure the "brightness" of deposits as to reproduce the normal impressions

THE NEW BELKE SCRAP ANODE BASKET

It has been the practice of electroplaters to sell all pieces of scrap anodes as junk, and thereby only realizing a small fraction of their actual cost. The new "SCRAP ANODE BASKET" brought out by the Belke Manufacturing Company of 947 N. Cicero Avenue, Chicago, Illinois, now makes this practice as wasteful as throwing away silver dollars.

With a new anode suspended in the center of this basket it is now possible to use up all short pieces in productive plating. The basket itself is made of steel wire mesh and is insulated with a heavy coating of Belke Hard Rubber. You merely hang it right on your cathode bar, suspend one new anode in the center and dump all your small pieces into the basket. Contact is obtained from the full size anode in the center.

This basket also comes with a filter bag which prevents any sludge or small pieces from poluting the solution. The Belke scrap anode basket can be made for any size tank and will save untold dollars in anode costs.

BELKE HARD RUBBER COVERED DIPPING BASKETS

In recent years the insulation of plating equipment with hard rubber has been responsible for many important improvements in the plating industry. The most important of these of course is the Hard Rubber Insulated Plating Rack. With the recent development of the Belke Anodic Process — which makes it possible to cover wire mesh or perforated steel with a heavy coating of hard rubber — the insulated dipping basket runs a close second.

This coating, which has been developed and perfected by the Belke Manufacturing Company of 947 N. Cicero Avenue, is impervious to boiling cleaners, caustics and alkaline solutions.

Another advantage of this type of dipping basket is in the handling of highly polished work. The rubber although it is hard, does not scratch the work as is the case with metal baskets.

Hard rubber dipping baskets are manufactured by the Belke Manufacturing Company, 947 N. Cicero Avenue, Chicago, Illinois. They can be had in any size and shape as well as with any handle arrangement.

of the human eye. "Total reflectivity" is misleading because it differs with different metals having apparently equally "bright" surfaces.

"Specular" reflection is that of a plane mirror, in which the angle of incidence is equal to the angle of reflection. "Diffuse" reflection is that at all other angles.

It was found that if both the specular and the diffuse reflection were measured, the visual brightness of the plated surface could be expressed by their relation, for example in such terms that the brightest surface, that is a perfect mirror, has a rating of 100. This method placed 6 silver deposits in the same order as by visual inspection. W. BLUM.

The etching of copper by ferric chloride solutions, B. BAARS and L. S. ORNSTEIN—Copper plates for intaglio (plate) printing are commonly etched with a solution of ferric chloride ("iron perchloride"). It was found that if the specific gravity of the ferric chloride solution was 1.48 or less, the copper dissolved smoothly and uniformly, but in more concentrated solutions, the rate of solution was slower and more variable. In the latter case, pyramidal etching figures were produced, which were not directly related to the structure of the copper. Potential measurements indicated that in the stronger solutions, an insoluble film of cuprous chloride formed on the surface of the copper and retarded solution. Copper deposited at high current densities is finer-grained and dissolves more rapidly than that deposited at low current densities. W. BLUM.

Structure of thin coatings of copper electrodeposited on crystalline copper, P. A. JACQUET—The author studied the crystal structure of thin layers of copper deposited upon either (a) electrolytic copper of (b) cast copper. Deposits on the former frequently showed a "dendritic" (tree-like) structure, with lines radiating from the center of the crystal present on the original surface. On cast copper, either a cellular or a striated deposit was produced. Old copper sulphate solutions give somewhat different structures than new solutions, probably because the former contain more cuprous ions. At low current densities the copper tends to deposit on certain "preferred" planes or active centers. W. BLUM.

Comparative properties of metallic surfaces polished mechanically and electrolytically, P. A. JACQUET—Recent researches have shown that when a metal surface is polished mechanically, that is, with fine abrasives, a very thin layer at the surface is probably amorphous (Beilby layer), and that just below this layer is a fairly thin layer of very finely divided metal. The author published previously a new "electrolytic polishing" method, in which a very bright surface is obtained on copper and brass by carefully controlled anodic etching in a solution containing 500 g/l (67 oz/gal) or ortho or pyro phosphoric acid. Lead and tin alloys are similarly brightened in a solution containing acetic acid and perchloric acid. Studies by this electrolytic treatment confirmed the above views of the surface structure. Hothersall

Secretaries
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has shown that when nickel is plated on polished brass, the adhesion is poor, and some of the brass adheres to the detached nickel. Etching or heat-treatment improves the adhesion. The adhesion is also improved by using electrolytic instead of mechanical polishing of the brass. The reflectivity of electrolytically polished copper is higher and more uniform than that of mechanically polished copper.

W. BLUM.

The crystal structure of copper electrodeposits, ARTHUR PHILLIPS and WALTER R. MEYER—It was found that in acid copper solutions, columnar crystals of the deposit that follow the structure of the base metal are formed up to about 9 amp/ft^2. The crystal structure of the base metal is reproduced in the deposit up to about 20 amp/ft^2. No reproduction of the base metal structure was observed in cyanide solutions at current densities as low as 1 amp/ft^2. Up to that current density the crystals from the cuanide bath are perpendicular to the surface. As little as 0.01 g/l (0.0013 oz/gal) of lead in a cyanide copper bath affects the structure of the copper, making it brighter at low current densities. Larger quantities of lead cause banded copper deposits. Addition of zinc has very little effect on the structure of copper from cyanide baths.

W. BLUM.

German electroplating practice, RICHARD SPRINGER—Full automatic plating plants are operated in Germany by the large motor car works and other factories, chiefly for depositing nickel, copper, and chromium. The medium size factories prefer the semi-automatic plating plants, such as travelling chain vats and circular vats with a rotating cathode ring. A new feature in full automatic barrel plants is the so-called reversion step, by which the goods in the plating barrel are transported two steps forward and one step backward. Great success has been achieved with the full automatic chromium plating barrel. About 60 automatic electrolytic wire galvanizing plants are in operation with a total consumption of about 300,000 amperes. Of the two bright nickel plating solutions that have been developed in Germany, one is mainly used in Germany while the other is used chiefly abroad. The nickel plating process is immediately followed by chromium plating. A shortage of nickel anodes exists, but there is a sufficient supply of nickel sulphate of German manufacture. In some cases, nickel anodes are prepared by depositing nickel on lead strips in separate vats and then used in normal nickel vats. Tin plating baths contain aromatic sulphonic acids and their salts and allow the production of bright deposits at high current densities. Brilliant tinplate is being produced by the electrolytic process, followed by rolling. About 90% of all cadmium baths are of the bright deposit type. Electroplating of nickel and chromium on aluminum and its alloys is now done by first dipping into a bath containing zinc, which deposits on the aluminum. It is next copper plated from a cyanide bath, and followed by nickel and chromium. The Ballay ferric dip has been abandoned in Germany. In a somewhat complicated process, aluminum is first anodized, the anodic

PROPOSED AMENDMENTS TO THE CONSTITUTION

We the members of Chicago Branch of the American Electro-Platers' Society in regular meeting this date, recommend to the Supreme Society in annual meeting, 1937 at New York, N. Y., the following amendment:

To Wit; Art. III. - Part I - Section 1 and 2.

The officers of the Supreme Society shall be, a President, a Retiring President, a First Vice-President, a Second Vice-President and a Third Vice-President.

The Executive Board shall consist of all the Supreme Officers.

To Wit; Part I. Article IV. Sec. 1, Page 3.

It shall be the duty of the President to preside at all meetings of the Supreme Society, to preserve order, to put all motions before the meeting if duly seconded, to decide all questions of order subject to an appeal to the meeting, to give the deciding vote in case of a tie, and shall in honor of his office, be a member of all committees. He shall call all special meetings and all meetings of the Executive Board that may be necessary, which shall be held at the Branch that is nearest the geographical center of the Society, based upon the location of all Branch Societies, and state in writing the object of such meeting. He shall appoint all committees not otherwise provided for; in the absence of an officer, appoint a member to act during his absence, and when an officer resigns, or dies, appoint a qualified member to fill out the unexpired term.

G. JELINEK, *President*,
J. W. HANLON, *Secretary*.

We of the Chicago Branch of the American Electro-Platers' Society wish to offer the following Resolution to the constitution of the aforesaid Society in convention, and hope that it may be included as part of the constitution, or as an amendment thereto.

To be known as Art. IX., Part 2, Section I.

Each Branch Society shall be entitled to one (1) vote for each ten (10) members, and where a Branch has less than 10 active members only one (1) may be allowed said branch.

Branch societies may send as many as three (3) delegates to represent them but the voting power shall be on the ratio of one (1) vote for each ten (10) members in good standing with the Supreme Society Secretary's Office on the opening day of the Annual Convention. The voting power may be divided by the delegates representing the Branch, per agreement or by instructions from the Branch, and the same to be registered with the Supreme Secretary at the start of any balloting.

And that all delegates must qualify as active members per the Constitution of our Society without any deviation, and the Credential Committee must report results of their findings before delegates can be seated.

G. JELINEK, *President*,
J. W. HANLON, *Secretary*.

At a regular business meeting of the Boston Branch on April 1st, 1937, it was voted to sponsor an amendment to the A. E. S. constitution viz.: Article II to be amended to read as follows:

ARTICLE II

Sec. 1. The membership shall consist of two classes to be called respectively: Active and Honorary.

Sec. 2. Active membership shall be open to any person (professing and showing) interest in the advancement of the Science and the Art of Electroplating and the dissemination of the knowledge of its practice.

Sec. 3 *to Sec.* 10. to read as written in the present Sec. 5 to Sec. 12.

ARTHUR MINTIE, *President*.
ANDREW W. GARRETT, *Secretary*.

film wholly or partially removed in a plating bath, and the article then plated in the usual manner. About 200 anodic oxidation plants are in operation. The anodic oxidation of aluminum has helped greatly in substituting aluminum for copper, brass, and nickel. The processes in use are the Eloxal, Alumilite and the well known Bengough process. The study of the pH of alkaline plating solutions is stressed. It is pointed out that brass baths work best with a pH from 9.5 to 10.2 and cadmium at a pH of 12.0. The formation of blisters in copper baths can be reduced by increasing the pH. A rather novel method is described for determining the pH of plating solutions. It consists of a special quality paper which is impregnated with 6 cross stripes of different colors. A wide stripe in the center is the indicator. In making a pH determination, the color imparted to the indicator strip is matched against the corresponding band on the unalterable scale of the 6 stripes of different colors. An improved method for determining zinc in a brass solution is described. The Bullard-Dunn process for descaling hardened steel is widely used with great success. The shortage of non-ferrous metals has led to the study of electroplating of non-metallic articles such as celluloid, bakelite and similar materials. It is predicted that many of these metal coated non-metallic articles will be retained even when sufficient metal supplies are again available. The plating of hard chromium is playing an important role. Any desired thickness can be obtained without peeling or brittleness. A patented process for depositing copper on cylinders for intaglio printing has been used with considerable success. The object is to deposit a copper layer with a thickness sufficient for one etching only, and to peel this layer off the base after etching and printing. This thin copper deposit leaves the bath so smooth that the previously necessary grinding, a costly operation, is eliminated and short treatment only is necessary to make the cylinder ready for etching.
P. W. C. STRAUSSER.

American practice in electroplating, GEORGE B. HOGABOOM—Reference is made to the work carried on at the National Bureau of Standards under the auspices of the American Electro-Platers' Society and in cooperation with the American Society for Testing Materials. While the vapor degreasing method is gaining favor in America, a subsequent cleaning in alkali is advantageous in removing packed dirt. Cathodic cleaning is recommended for removing fine steel particles that are magnetically attracted to the surface of the steel from the polishing operation. The depolarized or "depassified" anodes are rapidly displacing anodes of low purity. There is a difference of opinion as to the relative value of the high and low pH nickel solutions. In electrotyping, with controlled agitation, good copper deposits can be obtained from baths not containing addition agents such as phenolsulphonic acid. Carbonates do not form in brass and copper cyanide baths containing Rochelle salts. The pH of this solution should be maintained at about 11.3 colorimetric. Brass deposits for the vulcanization of rubber should contain 70% copper and 30% zinc. Electrozinc plating of wire by the "Tainton" process is in large production in America. Current densities of 1500 amp/ft^2 have been attained with success. The use of soluble zinc anodes at high current densities is also practical. The shortage of cadmium has resulted in the use of

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April 1, 1937

Branch	Elected	Reinstated
Detroit	26	6
Boston	15	
Dayton	12	
St. Louis	10	8
Bridgeport	9	1
Hartford	9	
Springfield	8	
Chicago	9	
Toledo	6	1
Grand Rapids	5	
Milwaukee	5	
Philadelphia	5	
Pittsburgh	5	
Toronto	5	
Waterbury	5	
Cleveland	4	
New York	4	
Montreal	3	
Rochester	3	2
Anderson	2	
Binghamton-Elmira	2	
Newark	2	5
Baltimore-Washington	1	
Los Angeles	1	
Cincinnati		1
New Haven		
Providence		
San Francisco		

bright zinc deposits. Electrodeposited tin is a potential competitor to hot dip tin. The present tin anodes are of the ball type. The anode current density must be such that there is sufficient oxidizing action to convert the stannite into stannate as rapidly as it is formed. Bright nickel solutions offered to date have their respective peculiarities, and good work is produced only under definite conditions. The nickel-cobalt solutions furnish consistent results both in small and large units.

P. W. C. STRAUSSER.

French nickel plating practice, M. BALLAY—The author introduces his paper with references to Brochet's book, published in 1908, which work is somewhat parallel with present day aims of the electroplaters. Rapid plating has been practiced on a commercial scale since 1929. Bright plating has not attracted so much attention in France as in other countries due to the fact that bright plating has been in regular production in France for quite a long time. In preparing parts for plating, the so-called "copper degreasing" method is still prevalent. This consists simply of an electrolytic cleaner containing caustic soda and sodium cyanide with some copper cyanide. It is claimed that very good adhesion of nickel deposits on both ferrous and non-ferrous alloys can be obtained if the basis metal has been subjected only to "copper degreasing", without any etching treatment. Since the advent of rapid plating, anodic etching of the ferrous alloys with sulphuric acid has been adopted. For non-ferrous materials, some shops are using Hothersall's citric acid anodic treatment and obtaining good adhesion of the deposits. Many shops still use 5.5 amp/sq.ft. for nickel plating. In the semi-rapid systems, higher current densities are used. The full automatic plating equipment is rare in France, but the semi-automatic equipment is frequently encountered. In most plants with the rapid or semi-rapid process, the ratio of total current in amperes to volume of bath in liters is from 0.20 to 0.25. All industrial nickel plating baths are operating at a pH of 5.0 or more. Bright nickel plating has been carried on since 1904 at which time the so-called "Persel" bath was put on the market. In 1927, an investigation was conducted by the engineers of the French Railways to determine what course to follow for improving the quality of electroplated finishes. The survey resulted in the formulation of specifications, which demanded that the average thickness of the outer nickel deposit shall be at least 0.0004 or 0.0008 inch. The plated pieces are also subjected to tests such as adhesion and corrosion. These specifications have resulted in a marked improvement of the quality of electroplated finishes.

P. W. C. STRAUSSER.

British electroplating practice, E. J. DOBBS—Nickel leads the list of deposited metals from the standpoint of tonnage. Its increase is attributed to the advent of chromium finishes. Typical nickel baths are of the single salt type containing boric acid and nickel chloride. The thickness of nickel for iron and steel articles is from 0.0006 to 0.001 inch, and for brass and non-ferrous metals from 0.0003 inch to 0.0006 inch. Except on zinc base die-castings, nickel is plated directly over the basis metals. Bright nickel plating

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is making slow but steady progress. Concentrated chromic acid baths, with 100—1 ratio, are used for decorative purposes, while less concentrated solutions are used for hard chromium plating. Cleaning nickel coatings prior to chromium plating is almost unknown. The copper sulphate bath is commonly used in the electrotyping trade with no addition agents. The copper cyanide bath is rapidly dying out. Brightening agents for cadmium plating are not popular, as the mette type of coating is preferred. It is claimed that the use of brighteners in cadmium baths results in their codeposition and therefore lessens considerably the protection against corrosion. The tin plating solutions are composed of stannous chloride, brown potash and a trace of glue. The sodium stannate solutions are making slow progress. The amount of zinc plating is quite small compared with the amount of nickel deposited. The acid zinc baths find preference over the cyanide bath. The substitution of zinc for cadmium has not threatened the demand for the latter to a very great extent. Rhodium plating has had a disappointing reception on account of the color and increased cost of the rhodium plated article.

P. W. C. STRAUSSER.

Modern electroplating machinery, JOHN KRONSBEIN. A full automatic conveyor nickel plating plant of novel design is described. Fundamentally, it is a combination of a slow motion main chain conveyor, which carries the cathode bars through the several vats in the line, and synchronized with it, a rapid transfer of work from one vat into the succeeding one. The transfer carriages are actuated by electro magnets which are raised or lowered by a winding mechanism. Another automatic machine of novel design is a double-disc wheel for chromium plating. The wheel is a magnet, the poles of which have been mushroomed out into discs of suitable diameter. Ferrous parts to be plated are held either directly upon the magnetic edge of the disc or upon magnetized jigs that are attached to the wheel. Non-ferrous parts are held by suitable spring clips to a magnetized jig. The metal rectifier is described in detail. Its advantages over a motor generator set are (1) ease of control, (2) lower running costs, (3) increased reliability and (4) flexibility of installation. Curves show the power factor, and the efficiency at constant current and constant voltage. The total capacity of rectifier installations for electroplating approaches 300,000 amperes. P. W. C. STRAUSSER.

Modern developments in the electrodeposition of gold, H. W. J. POPE—A discussion is given of a method of electrodepositing colored gold from cyanide baths by depositing alloys. It is also possible to vary the color by variations in current density in ordinary gold solutions. The "free cyanide" must be controlled. Formerly, to estimate gold in cyanide baths, they were treated with concentrated acid to destroy the cyanide and the gold was precipitated by one of many reducing agents. A simpler method is to fuse the salt or evaporated solution with potassium bisulphate, when the gold is precipitated and after dilution with distilled water, is filtered off, ignited, and weighed. C. KASPER.

Developments on the electrodeposition of the platinum metals, K. SCHUMPELT. There are two principal plating baths for platinum. The

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first is made by boiling chlorplatinic acid or ammonium chlorplatinate with a mixture of sodium and ammonium phosphates. A new complex is formed as is evidenced by a change in color. The cathode efficiency is low, the recovery of the platinum from spent solutions is difficult, and the life of the bath is short, because replenishing can be done only by adding platinic chloride. The second bath is the Zschiegner bath, which contains platinum di-ammino nitrite, with sodium nitrite and ammonium nitrate as conducting salts. In this bath there is no accumulation of salts, since the ammonia and oxides of nitrogen are eliminated by secondary reactions. The cathode efficiency is comparatively low, and is uncertain owing to existence of the platinum in the bivalent and quadrivalent form. The temperature of operation is 82—93° C and ammonia has to be added from time to time. Scratch brushing of the deposit is advisable.

Development of palladium plating is desirable because of its relative cheapness.

Rhodium plating is done from a solution of rhodium sulphate or phosphate in sulphuric or phosphoric acids. The temperature is from 20° C to 60° C and the current density from 10 to 100 amp/ft^2. A bright deposit 0.00006″ thick does not require any buffing. The throwing power approaches that of gold and silver in cyanide solutions. Due to the high price of rhodium the amount of deposit varies from a mere flash up to 0.000008 of an inch. In addition to plating of jewelry and silverware, rhodium has found a very important application on reflectors. Of all the metals, the color of rhodium most nearly approaches that of freshly polished silver. Taking freshly polished silver as 100%, rhodium shows a reflectivity of 78—82% over the visible range of the spectrum, and decreases only slightly in the ultra-violet region, where silver drops far below rhodium.

C. KASPER.

Electrodeposition of platinum: Historical and general review, R. H. ATKINSON—This is a historical review of platinum plating. Platinum was first applied by mechanical cladding and by methods similar to gilding, which was the status up to 1840. Platinum was first electrodeposited in 1841, from a "nitro-muriate" of platinum; the name of the contributor being unknown. In 1846 Howell suggested the stabilized platinate electrolyte, which solution is made up by dissolving platinum oxide in caustic alkali and stabilized by the addition of oxalic and tartaric acids.

The ammonio-phosphate bath dates back to a patent issued to Roseleur and Lannaux in 1855. This bath is made up by adding to a solution of platinum chloride some ammonium phosphate. A precipitate occurs, and then to this mixture is added sodium phosphate and sodium pyrophosphate. The mixture is boiled for four hours, and the bath is ready to use. Wohl in 1890 tried out both methods very thoroughly and concluded that the ammonio-platinic phosphate bath is the better of the two, but is not as suitable as the stabilized platinate bath from the standpoint of keeping up the metal content, due to the accumulation of salts. The modern processes are (1) The Roseleur Process. (2) The Keitel and Zscheigner bath, which bath uses the

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dinitro-diammino salt with sodium nitrite and ammonium nitrate for conducting salts. (3) The platinate bath. Electrolytic processes are not suitable for the refining of platinum. Rhodium plating has displaced platinum, because it can be deposited with equal facility and has advantages in reflectivity, whiteness, nobility and covering power. C. KASPER.

Platinum plating from alkaline solutions, E. C. DAVIES and A. R. POWELL—The composition of the bath is:

Sodium hexa-hydroxyplatinate	11.1 troy oz/gal
Pure caustic soda	3.1 avoir. oz/gal
Sodium oxalate	3.1 " "
Anhydrous sodium sulphate	18.7 " "

When the platinum salt content drops to about half of the above concentration the throwing power decreases. Higher concentrations of platinum salt give a higher throwing power.

Temperature of operation is 65—80° C, current densities are of the order of 7.5 amp/ft^2. The current efficiency is 100%. Platinum anodes (which are insoluble) should be used, but copper sheets plated with platinum (2 g of platinum per sq.ft. of anode surface) may be used. The most satisfactory metals that can be plated with platinum are karat golds, sterling silver, silver electroplate, copper, brass, and some grades of nickel silver. Other metals such as iron, steel, zinc, soft solders, nickel, chromium, and some nickel silvers cannot be plated directly, but they can be plated if an intermediate plate of copper, gold, or preferably silver, (on account of its white color), is first applied. The products are generally bright, but sometimes finishing with a soft mop with the finest rouge on the mop is necessary. The best method of treating imperfect plates is to plate over with copper or silver from the cyanide bath, polish, clean, and replate with platinum.

The metal content is kept up by adding specially prepared hexa-hydroxyplatinate. Caustic soda must be added from time to time. If in the cleaning operation for any reason cyanides are used, care must be exercised that no cyanide enters the platinum bath. Small amounts cause the plate to be patchy, larger amounts entirely prevent plating. Good deposits up to 0.1 inch have been made from this bath but the usual deposit is 0.000025 inches. The future of platinum plating lies in industrial applications.

C. KASPER.

Inclusions in electrodeposits, their origin and their effect on the structure and mechanical properties, MICHEL CYMBOLISTE. Inclusions may be caused by foreign material or insoluble compounds formed in the cathode film. Small inclusions or colloidal material produce a fine crystal structure. Large inclusions distort the crystal growth in the vicinity and may produce large crystals.

Naphthalene sulphonate in a nickel bath increased the hardness of the deposit and produced a fine structure. The hardness depended on the concentration of sulphonate and reached a maximum of 555 at 0.5 g/l. Inclusions in deposits cause a lowering of the mechanical strength. Many photomicrographs are given to illustrate the effect of inclusions on crystal structure.

A. BRENNER.

NOTICE

to members and friends of the A.E.S.

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Optical research of thin layers, L. S. ORNSTEIN and P. J. HARINGHUIZEN—The corrosion of metals by oils has been determined previously by measuring the change in the transmission of light through a thin layer of the evaporated metal after it had been corroded. By the above method the authors compared the corrosion of electrodeposited copper with that of the evaporated metal film, and found about the same degree of corrosion for both types of films. Since the electrodeposited film must be much thicker than the evaporated film to produce the same decrease in light transmission, the results with the electrodeposits are less accurate than those with evaporated films. A. BRENNER.

A method of obtaining adherent electrodeposits on chromium and stainless steel, G. E. GARDAM—Chromium can be plated with nickel in a bath consisting of

	g/l	oz/gal
nickel sulphate	240	32
Sulphuric acid	50	7

Current density = 150 amp/ft^2

After 5 minutes plating in the above bath, plating is continued in an ordinary nickel bath. The adherence of the second nickel deposit is increased by annealing at 200° C or by an intermediate copper deposit.

The adhesion of chromium to various types of surfaces was measured both qualitatively and quantitatively. The adhesion of chromium to a polished nickel deposit was good, whether the nickel surface was simply wiped or cathodically cleaned before plating. Good adhesion was obtained on steel treated anodically in either sulphuric acid or in the chromium plating bath. Fair adhesion of nickel to chromium-iron alloys may be obtained by the above method, and soldering may be done to the thin nickel layer.

A. BRENNER.

The adhesion of electrodeposited nickel to nickel, A. W. HOTHERSALL—Oxide films on nickel are responsible for the lack of adhesion of nickel deposited on nickel. The oxide film may be detected by plating for 30 seconds in an acid copper bath at 0.1 volt. In the presence of an oxide film, copper deposits in patches, but plates uniformly on an oxide-free surface. Oxide films can be removed by cathodic or anodic treatment in sulphuric acid or by immersion in hydrochloric, nitric, or sulphuric acid.

Rubbing with emery of filing a nickel surface weakens the surface layer so that the adhesion of a subsequent nickel deposit is poor. Good adhesion is obtained on such surfaces by anodic etching in sulphuric acid or by interposition of a copper layer. The adhesion of nickel to a polished nickel surface is food. A BRENNER.

Comments on the electrolysis of solutions of complex salts, A. GLAZUNOV and M. SCHLÖTTER—The authors review the various theories that have been proposed to explain the mechanism of metal deposition from complex salt solutions and conclude that the theory of Glasstone is the most satisfactory one. This assumes the existence of complex cations, which first discharge and then deposit metal produced by secondary chemical de-

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composition of the discharged ions. The complex cations originate from complex anions by means of a special type of ionization. The theory is believed to account not only for the fine-grained deposits produced, but also for the possible inclusion of salts which may have entered the space lattice of the cathode deposit. M. R. THOMPSON.

The cyanide cadmium plating solution, G. SODERBERG—This paper is an extensive correlated abstract of the literature on cyanide cadmium solutions including data obtained by the author and his associates.

The complex double cyanide present in cadmium plating baths is probably represented approximately by $Na_2Cd(CN)_4$, although some $Na_2Cd(CN)_3$ may be present.

Data are included for resistivity, static potential, polarization, cathode and anode efficiency, throwing power, appearance and mechanical properties of the deposit, effect of addition agents, etc. In practice, much reliance is placed on one or more addition agents. "The coatings obtained without addition agents are at their best, fine-grained and white, but burnished bright lustre cannot be had without addition agents.....The hardest plates are always found within the bright plate range of the solution."

The paper does not include such subjects as electrodeposited cadmium alloys, the analysis and control of the plating bath, the testing of deposits and the corrosion-protective value of cadmium on steel.

M. R. THOMPSON.

A resumé of silver plating, F. C. MESLE—This paper gives a very clear exposition of silver plating methods in the United States, followed by data on current and metal distribution and a comparison of four methods for estimating the thickness of deposits. For numerous details, the paper itself should be consulted.

A few points of general interest will be noted. Potassium cyanide is still considered superior to sodium cyanide in silver baths, after an experience of over 20 years. It permits the use of higher current densities and favors better deposits. "Carbon disulphide as a brightener is still a matter of individual judgment and it is difficult to standardize its use." Raising the temperature makes necessary an increase in current density to maintain a given color of deposit, but the current distribution tends to become less uniform. This condition can be partly taken care of by racking and by suitably placing the areas requiring reinforced plating. In practice, the average current density is less than 20 amp/sq.ft., but silver can be deposited experimentally at 200 amp/sq.ft. M. R. THOMPSON.

Zinc and cadmium plating in the U. S. S. R., N. A. ISGARISCHEV—The composition is given of typical zinc and cadmium baths used industrially in the U. S. S. R., both of the acid and cyanide type for each metal. The use of acid cadmium baths, such as the following seems noteworthy:

(1). Cadmium sulphate, 20—40 oz/gal.; ammonium sulphate, 8 oz/gal.; peptone 0.3 oz/gal; pH 3—4; current density about 7 amp/sq.ft.

(3). For conveyor plating. Cadmium sulphate, 47—50 oz/gal; boric

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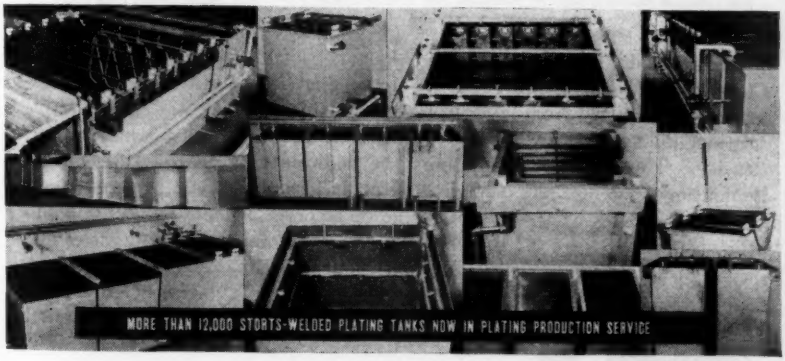

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acid, 1.5 oz/gal.; glue 0.13 oz/gal.; current density 1400 amp/sq.ft.; temperature 104°F; air agitation.

The authors studied the effect of various conditions upon polarization in acid zinc and cadmium solutions. Attention is called to the bearing of polarization curves upon conservation of energy in electrodeposition. Some unusual effects on polarization, found especially in acid cadmium solutions, are discussed from the aspect of ion hydration. N. R. THOMPSON.

A chemical study of alkaline cyanide degreasing and coppering baths, A. CHAYBANY—Cleaning and copper plating, chiefly of nonferrous metals, was effected in a strongly alkaline bath placed in a steel tank and containing copper cyanide, 0.7 oz/gal.; sodium cyanide, 7 oz/gal.; and sodium hydroxide, 11 oz/gal. Anodes were either steel or copper; current density about 40 amp/sq.ft.; voltage about 8; time from 1 to 1-1/2 minutes; temperature not stated. The articles were subsequently plated with bright cobalt followed by chromium.

The bath tended to deteriorate through the accumulation of dissolved zinc from articles cleaned and through oxidation of cyanide to cyanate. Chemical studies showed that the deterioration could be controlled by additions of sodium sulphide and sodium hydrosulphate, with the use of copper anodes. The amount of the additions depends upon the rate of working of the bath.

M. R. THOMPSON.

Laminated Chromium Plating, Part I, by Dr. R. J. PIERSOL. *Metal Cleaning & Finishing*, March, 1937—In laminated deposits, internal stresses are not transmitted from layer to layer, and therefore, are not accumulative. Distinct laminations are secured by intermittant deposition at high current density. The removal period must be sufficiently long to cause distinct laminations, but not long enough to result in loss of cohesion between layers. Normally, this period is between 30 and 60 seconds. The thickness of laminations should be from 0.2 to 0.4 mils. Worn chromium plated articles may be replated without stripping. Upon immersion in the bath, the current polarity is reversed for several seconds. Deposition is then continued in the usual manner for laminated structures. E. T. SHEEHAN.

METALS AND ALLOYS ABSTRACTS

Improved Method for Electrodepositing Alloys. H. KERSTEN and WM. T. YOUNG. *Ind. & Eng. Chem.*, Vol. **28,** Oct., 1936, pp. 1176-77—An improved method for electrodepositing alloys (U. S. Patent 1,924,439, 1933) described for nickel-iron alloys, is the one in which the bath is kept saturated with respect to a salt of one of the metals, Ni formate, and the salt of the other, ferrous sulfate, is added continuously or at frequent intervals. An insoluble anode is used and the pH of the solution is kept constant by frequent additions of a neutralizing substance or by passing the electrolyte continuously over a solid neutralizing substance. The process satisfactory only when (a) one of metals can be electrodeposited from a saturated solution (b) the solutions do not react disadvantageously with each other chemically,

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and (c) a suitable neutralizing substance can be found. The method has also been applied to alloys of cobalt and nickel, gold and nickel.

PHIL J. RITZENTHALER.

Electroplating with silver. A. R. POWELL and E. C. DAVIES. *Chemical Trade Journal & Chemical Engineer*, Vol. **99,** Sept. 4, 1936, p. 196—Abstract of British Patent 450,979 for direct production of bright hard deposits. Colloidal solution of an alkali metal silicate, or of a soap, including sulphonated soaps, is added to plating bath containing an organic sulfide and an excess of free alkali metal cyanide. PHIL J. RITZENTHALER.

New cylinder treatment. *Engineer*, Vol. **162,** Oct. 9, 1936, p. 378—Describes new process for the treatment of internal combustion engine cylinder to reduce wear, developed by R. A. Lister and Co., Ltd. Dursley: known commercially as the "Listard" process. It consists in depositing chromium, by electro-chemical means, on cast iron giving surface of great hardness. No details of processes are given, but gives results of experiments on wearing quality of deposits. Process is based on a Dutch invention developed in 1935. Process should have wide application in this country.

PHIL J. RITZENTHALER.

Health Hazards in Industrial Electroplating Plants. C. B. F. YOUNG. *Steel*, Vol. **99,** July 6, 1936, pp. 63-4—Points out possible dangers connected with plating bath other than chrome and a few other recently developed processes, by describing case resulting in one death and affliction of eleven. Adequate ventilation and scientific control of plating bath will correct such conditions. PHIL J. RITZENTHALER.

Effect of Ultra-sonic Radiation on Electrodeposits. W. T. YOUNG and H. KERSTEN. *Journal of Chemical Physics*, Vol. **4,** July 1936, 426—Ripples in electrodeposits of several metals and alloys resulting from the impingement of sound waves during deposition were investigated, bath composition, current density, time, and character of deposit, indicate that stationary waves are set up in the solution, and the concentration of metal ions is relatively higher in layers separated by half wave lengths. The best ripples were obtained from concentrated solutions of Fe or Zn salts, good ripples from black Ni solutions, and poor or no ripples in Co, Cadmium, Chrome & Brass. PHIL J. RITZENTHALER.

Electrolytic Patina on Copper and Its Alloys. A. CHAPLET. *Cuivre et Laiton*, Vol. **9,** Sept. 15, 1936, pp. 391-403—Electrolytic Patina on copper can be produced in following bath as anode:

Mg SO_4 — 10 g.	Current Density = 4 amps per sq. dec.
Mg hydrate — 2 g.	
Potass. Bromide — 2 g.	for 15 min, at 95°C.
Water — 100 g.	

Cu is covered by Cu SO_4 and Cu $(OH)_2$ which turns to $CuSO_4$. 3 $Cu(OH)_2$ which is natural patina. Slight variations for brasses and other alloys.

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